

Special Foldout: Exploring the Solar System

AIR & SPACE

Smithsonian • April/May 1993

**FREE
POSTER**

AIRSHOW!

All the sky's a stage...

STAR TREK
at the
Smithsonian

Does Planet X Exist?

\$3.50 U.S./\$4.50 Canada



YOU WON'T
FIND THE
NEW INTREPID'S
WINDSHIELD
IN THE
USUAL PLACE.



We started by changing everything...even the placement of Intrepid's windshield.

We found that by moving the leading edge of the windshield six inches forward and three inches lower,

we could improve

Intrepid's aerodynamics

while significantly reducing wind noise. A larger windshield meant enhanced visibility as well.

Of course, there were other benefits to Intrepid's revolutionary cab-forward design, like a roomier backseat and wider rear doors. All in all, cab-forward means less room for machinery and more room for people.

And now that we've seen what's possible in a four-door sedan, we can't see building one any other way.

- Standard driver & front passenger airbags
- Available integrated child seat
- Standard rear seat heat & air ducts
- Available automatic temperature control system
- Standard four-wheel independent suspension
- Available anti-lock brakes & traction control
- Available 5.5 liter, 214 horsepower, 24-valve overhead cam V-6
- Choice of warranties: 7/70 powertrain or 5/56 bumper-to-bumper. See these limited warranties & restrictions at dealer. Excludes normal maintenance, adjustments & wear items.
- For still more information, call 1-800-4-A-DODGE

Select
Features



"Intrepid revolutionizes the architecture of the automobile with cab-forward design."


-Popular Science

"Legroom and headroom are generous."

-Automobile Magazine

INTREPID  THE NEW DODGE

A DIVISION OF THE CHRYSLER CORPORATION

A high-angle, black and white photograph of a car's interior. The view is from the passenger side looking towards the driver's seat. Two leather-upholstered seats with horizontal stitching are visible. A center console with a gear shifter and handbrake is positioned between the seats. The steering wheel is partially visible on the right side of the frame. The overall lighting is dramatic, with strong highlights and deep shadows.

"Visibility is about as
good as it gets."

-Car and Driver

"The seats are comfortable,
controls are easy to find
and the tactile feel is superb."

-Motor Trend

Buckle up for safety.

BEYOND
EARTHA CELEBRATION
OF SOLAR
SYSTEM
EXPLORATION

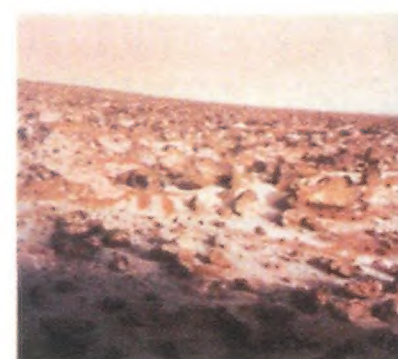
Name	Launch Date	Mission
Pioneer 4 (US)	3/3/59	Originally a lunar probe; sent into solar orbit.
Pioneer 5 (US)	3/11/60	Solar orbit.
Venera 1 (USSR)	2/12/61	Venus flyby; contact lost at 4.7 million miles.
Mariner 2 (US)	8/27/62	Venus flyby (22,000 miles) on 12/14/62.
Mars 1 (USSR)	11/1/62	Mars flyby; contact lost at 65.9 million miles.
Zond 1 (USSR)	4/2/64	Venus flyby; contact lost.
Mariner 3 (US)	11/5/64	Mars flyby; probe's shroud failed to eject during launch.
Mariner 4 (US)	11/28/64	Mars flyby (6,100 miles) on 7/14/65; photos returned.
Zond 2 (USSR)	11/30/64	Mars flyby; no data returned.
Venera 2 (USSR)	11/12/65	Venus flyby; data not returned.
Venera 3 (USSR)	11/16/65	Venus impact on 3/1/66; data not returned.
Pioneer 6 (US)	12/16/65	Solar orbit.
Pioneer 7 (US)	8/17/66	Solar orbit.
Venera 4 (USSR)	6/12/67	Venus atmospheric entry on 10/18/67; 94 minutes of data transmitted.
Mariner 5 (US)	6/14/67	Venus flyby (2,500 miles) on 10/19/67.
Pioneer 8 (US)	12/13/67	Solar orbit.
Pioneer 9 (US)	11/8/68	Solar orbit.
Venera 5 (USSR)	1/5/69	Venus atmospheric entry on 5/16/69.
Venera 6 (USSR)	1/10/69	Venus atmospheric entry on 5/17/69.
Mariner 6 (US)	2/24/69	Mars flyby (2,100 miles) on 7/31/69.
Mariner 7 (US)	3/27/69	Mars flyby (2,200 miles) on 8/5/69.
Venera 7 (USSR)	8/17/70	Venus landing on 12/5/70; 23-minute transmission.
Mars 2 (USSR)	5/19/71	Mars orbiter/lander; arrived 11/27/71; lander, first Earth object on Mars, crashed.
Mars 3 (USSR)	5/28/71	Mars orbiter/lander; arrived 12/3/71; second object from Earth on Mars.
Mariner 9 (US)	5/30/71	Mars orbit on 11/13/71.
Pioneer 10 (US)	3/2/72	Jupiter flyby (81,000 miles) on 12/3/73.
Venera 8 (USSR)	3/27/72	Venus landing on 7/22/72.
Pioneer 11 (US)	4/5/73	Jupiter flyby (26,660 miles) on 12/2/74; Saturn flyby (13,000 miles) on 9/1/79.
Mars 4 (USSR)	7/21/73	Mars orbiter failure; flew by (1,400 miles) on 2/10/74.
Mars 5 (USSR)	7/25/73	Mars orbiter; arrived 2/12/74.
Mars 6 (USSR)	8/5/73	Mars lander; arrived 3/12/74; transmissions ceased before landing.
Mars 7 (USSR)	8/9/73	Mars lander; lander missed by 800 miles on 3/9/74.
Mariner 10 (US)	11/3/73	Venus flyby (3,600 miles) on 2/5/74. Mercury flybys 3/29/74 (460 miles); 9/21/74 (30,000 miles) and 3/16/75 (200 miles).
Helios 1 (Germany)	12/10/74	Solar orbit.
Venera 9 (USSR)	6/8/75	Venus orbiter/lander; landed 10/22/75; first pictures from surface.
Venera 10 (USSR)	6/14/75	Venus orbiter/lander; landed 10/25/75; pictures returned.
Viking 1 (US)	8/20/75	Mars orbiter/lander; arrived 6/19/76, landed 7/20/76.
Viking 2 (US)	9/9/75	Mars orbiter/lander; arrived 8/7/76, landed 9/3/76.
Helios 2 (Germany)	1/15/76	Solar orbit.
Voyager 2 (US)	8/20/77	Jupiter flyby (400,000 miles) on 7/9/79; Saturn flyby (63,000 miles) on 8/25/81; Uranus flyby (44,000 miles) on 1/24/86; Neptune flyby (15,500 miles) on 8/25/89.
Voyager 1 (US)	9/5/77	Jupiter flyby (174,000 miles) on 3/5/79; Saturn flyby (77,000 miles) on 11/12/80.
Pioneer V 1 (US)	5/20/78	Venus orbiter and surface radar mapper; arrived 12/4/78.
Pioneer V 2 (US)	8/8/78	Venus atmospheric probes; arrived 12/9/78.
ICE (US)	8/12/78	Originally the International Sun-Earth Explorer 3. Solar orbit; flyby of Comet Giacobini-Zinner (4,300 miles) on 9/11/85; flyby of Halley's Comet (17.4 million miles) on 3/25/86.
Venera 11 (USSR)	9/9/78	Venus flyby/lander; landed on 12/25/78.
Venera 12 (USSR)	9/14/78	Venus flyby/lander; landed on 12/21/78.
Venera 13 (USSR)	10/30/81	Venus flyby/lander; landed on 3/1/82; chemical analysis and pictures.
Venera 14 (USSR)	11/4/81	Venus flyby/lander; landed on 3/5/82; chemical analysis and pictures.
Venera 15 (USSR)	6/2/83	Venus orbiter and radar mapper; arrived 10/10/83.
Venera 16 (USSR)	6/7/83	Venus orbiter and radar mapper; arrived 10/14/83.
Vega 1 (USSR)	12/15/84	Venus flyby/lander/balloon probe; flew by (24,000 miles) and released probe and lander on 6/11/85; Halley's Comet flyby (5,500 miles) on 3/6/86.
Vega 2 (USSR)	12/21/84	Venus flyby/lander/balloon probe; flew by (15,000 miles) and released probe and lander on 6/14/85; Halley's Comet flyby (5,000 miles) on 3/9/86.
Sakigake (Japan)	1/7/85	Halley's Comet flyby (4.33 million miles) on 3/11/86.
Giotto (ESA)	7/2/85	Halley's Comet flyby (375 miles) on 3/14/86; Comet Gregg-Skjellerup flyby (125 miles) on 7/10/92.
Suisei (Japan)	8/18/85	Halley's Comet flyby (93,600 miles) on 3/8/86.
Phobos 1 (USSR)	7/7/88	Mars/Phobos orbiter/lander; contact lost.
Phobos 2 (USSR)	7/12/88	Mars/Phobos orbiter/lander; arrived Mars 1/29/89; contact lost 3/27/89.
Magellan (US)	5/4/89	Venus orbiter and radar mapper; arrived 8/10/90.
Galileo (US)	10/18/89	Jupiter orbiter/probe; Venus flyby (10,000 miles) on 2/10/90; asteroid Gaspra flyby (1,000 miles) on 10/29/91; scheduled to fly by asteroid Ida on 8/28/93 and reach Jupiter on 12/7/95.
Ulysses (ESA/NASA)	10/6/90	Sun polar mission; en route for 1994 arrival.
Mars Observer (US)	10/25/92	Mars orbiter; en route for 1993 arrival.

Does not include launch failures, probes that failed to leave Earth orbit, or lunar missions.



INTERCOSMOS

For more than three decades humans from Earth have been sending robot probes out on voyages of discovery across the solar system. Use the table here in conjunction with the graphic supplement provided with this issue as a log of this epic age of discovery.



NASA

Space probes have returned images from the surfaces of two planets, Venus (taken by Venera 13, top) and Mars (taken by Viking 2, above).

AIR & SPACE

Smithsonian

CONTENTS

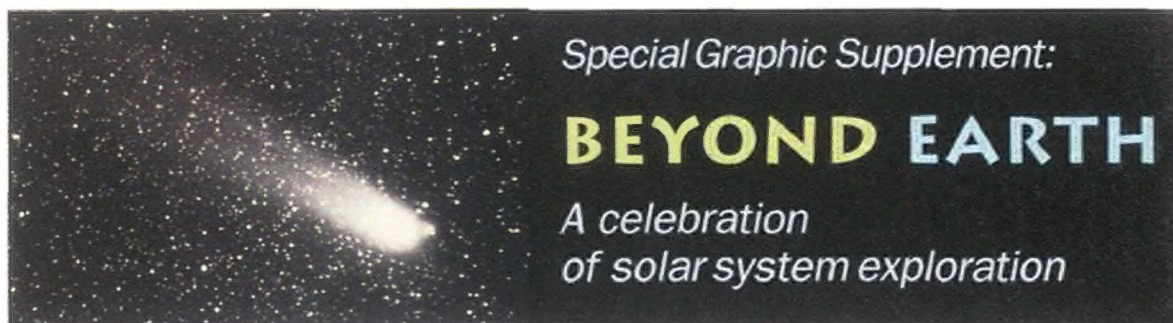


74 HERE LIES QUENTIN ROOSEVELT BY WILLIAM JEANES

ILLUSTRATIONS BY KAREN BARNES/
WOOD, RONSAVILLE, HARLIN

HE WAS JUST
ONE OF MILLIONS
WHO DIED IN WORLD WAR I,
EXCEPT QUENTIN WAS
THE SON
OF A PRESIDENT.

- 24 Race to the Sun's Edge** by Gerrit L. Verschuur
Four space probes look for what may truly be the final frontier: the outer limit of the solar system.



Special Graphic Supplement:

BEYOND EARTH

A celebration
of solar system exploration

- 32 Now Playing at an Airport Near You** by Phil Scott
Photographs by Lee Battaglia
There's no business like airshow business.

- 42 Essay: A League of Nations** by A.D. (Bert) Welliver
How it's possible to protect yourself to death.

Astronomy's Most Wanted: Fourth in a Series

- 46 Is Something Out There?** by Frank Kuznik
Most people believe there are nine planets in the solar system. Robert Harrington thought there were 10.

- 54 Pictures from St. Petersburg** by Slava Olshevski
From Russia with wings.

- 60 The Flight Attendants** by Diane Tedeschi
Illustrations by Steve McCracken
Once they were stewardesses.

- 68 Star Trek: The Final Curtain** by the Editors
of *Air & Space/Smithsonian*
Photographs by Caroline Sheen
Cancelled after only three seasons, Star Trek later became a phenomenon—and then a Smithsonian exhibit.



Cover:
Airshow veterans The French Connection take their act straight up in a photograph by Jim Koepnick.

Departments			
4	Viewport	31	The Smithsonian Traveler
6	Letters	80	Oldies & Oddities
12	Soundings	82	Reviews & Previews
18	In the Museum	86	Credits/Calendar
20	Above & Beyond	87	"The Satellite Sky" Update
22	Flights & Fancy	87	Forecast
		88	Collections

AIR & SPACE/Smithsonian (ISSN 0886-2257) is published bimonthly by the Smithsonian Institution, 900 Jefferson Drive, Washington, DC 20560. ©Smithsonian Institution, 1993. All rights reserved. Reproduction in whole or in

part without permission is prohibited. Subscription price: \$18 a year in U.S. possessions, \$24 elsewhere. Eighty-five percent of dues is designated for magazine subscriptions. Single-copy price: \$3.50. Second-class postage paid at

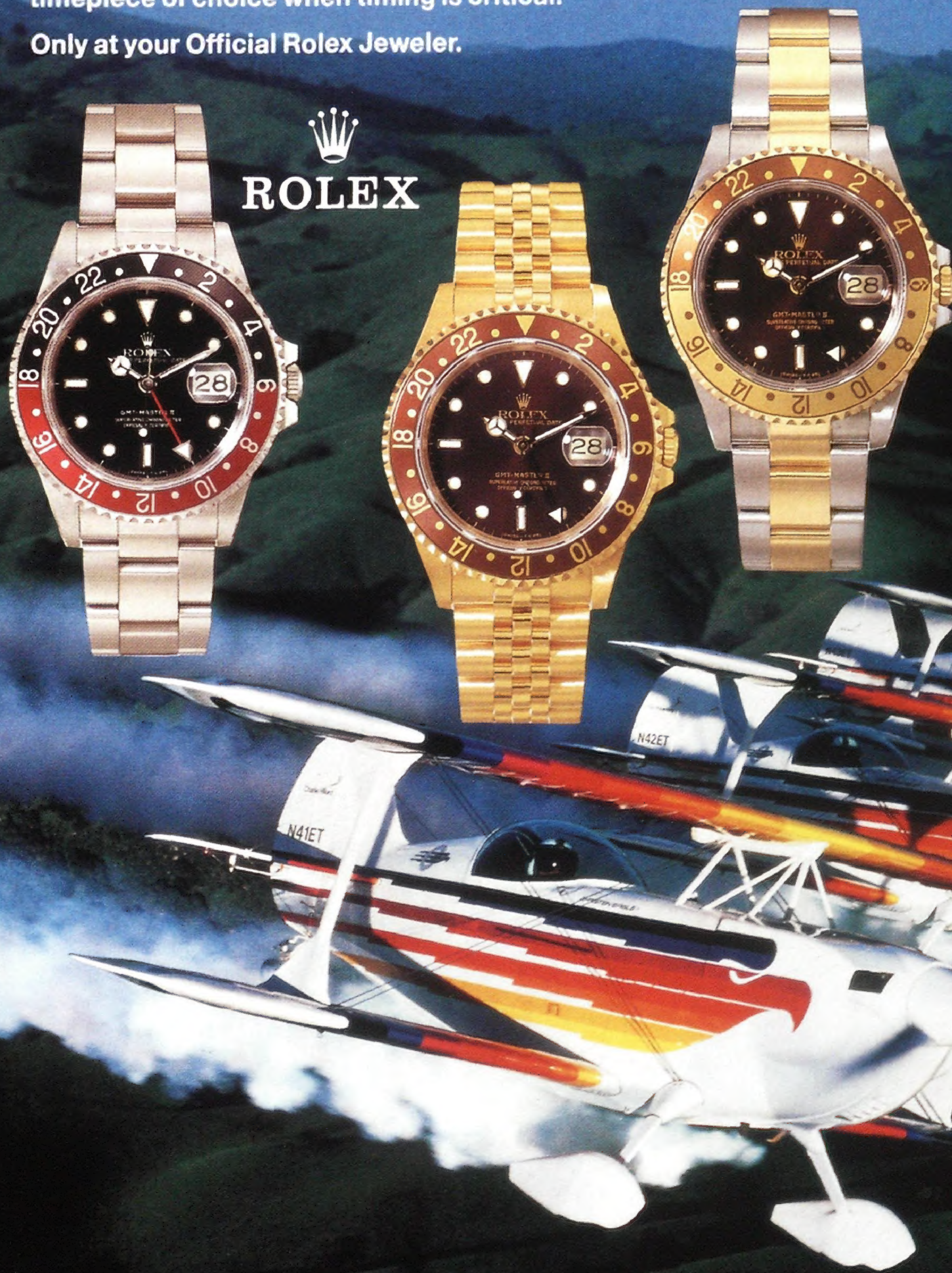
Washington, DC, and additional entry points. Editorial offices: 370 L'Enfant Promenade SW, 10th Floor, Washington, DC 20024. Advertising and circulation offices: 420 Lexington Ave., New York, NY 10170. Members: Address all

subscription correspondence and change-of-address information to P.O. Box 53261, Boulder, CO 80322-3261. Postmaster: Send address changes to *AIR & SPACE/Smithsonian*, P.O. Box 53261, Boulder, CO 80322-3261.

FLYING EXCELLENCE: ROLEX AND THE EAGLES

Snap rolls, hammerheads, Cuban eights...these daring and intricate airborne maneuvers are just part of the Eagles Aerobatic Flight Team's vast repertoire. Flying wingtip-to-wingtip at speeds of 200 mph, often only six feet off the deck, the Eagles must perform with split-second timing. These gifted pilots wear the timepiece they can trust: The Rolex GMT-Master II Oyster Perpetual Date with an independent 24-hour hand and bezel. Available in stainless steel, 18kt. gold or a combination of steel and gold...It's your timepiece of choice when timing is critical.

Only at your Official Rolex Jeweler.



Secretary of the Smithsonian Institution
Robert McC. Adams

Editor
George C. Larson

Managing Editor
Tom Huntington

Senior Editor
Linda Musser Shiner

Departments Editor
Patricia Trenner

Senior Associate Editor
Perry Turner

Associate Editors
Karen Jensen
David Savold
Diane Tedeschi

Photography/Illustration
Caroline Sheen

Design Consultation
Phil Jordan
Julie Schieber

Publisher
Ronald C. Walker
Mary D. Haskin, Assistant

Administration
Carey O. Randall, Associate Publisher

Advertising
Louis C. Kolenda, Director

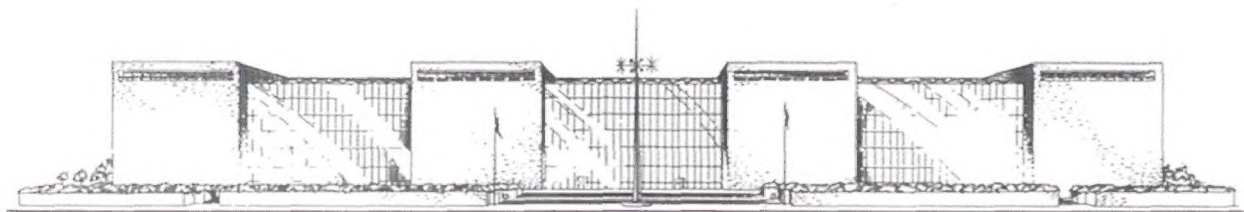
Circulation
Gale Page, Director
Margaret Moore
Paula J. de Brito

Production
Sarah D. Kingsley, Manager
Kristine L. Roberts

Business
Shelia Perry Brannum, Manager

Founder
Walter J. Boyne

Publisher Emeritus
Joseph J. Bonsignore



And the Winner Is...

The National Aeronautic Association has awarded this year's Collier Trophy, arguably the most prestigious award in aviation and spaceflight, to the Global Positioning System (GPS) team. GPS consists of two dozen satellites that continuously orbit Earth; the array offers amazingly precise data on the location of anything, anywhere, anytime.

In terms of impact on our society, GPS is likely to rival the automobile, the telephone, and the airplane, and there are scores of applications that are only just becoming apparent. (Last June, *Air&Space/Smithsonian* writer Frank Kuznik described GPS in the article "You Are Here.") At any given time, at least four satellites in a planned array of 24 are above the horizon for every point on Earth. The atomic clock timing signals that a radio receiver records from those four satellites are readily converted into the receiver's horizontal and vertical position by simple, computer-assisted triangulation.

Pilots who, like me, have at some time lost their way will soon find such misadventures a thing of the past. If you have a GPS receiver in your aircraft or even your car, you can always identify precisely where you are. Couple that to a map in your computer memory and it's virtually impossible to lose your way, no matter how bad the weather or how dark the night.

Military applications, which stimulated the development of GPS, were thoroughly exploited in the Gulf war, where finding one's way through a featureless desert or navigating aircraft to an invisible nighttime target proved effortless.

But that isn't all. GPS also permits you to compare your clock with that of anyone else on Earth. This transfer of time from one point to another, crucial to a variety of highly accurate measurements and once possible only by flying ultra-precise atomic clocks from laboratory to laboratory, now becomes routine.

It facilitates timing the arrival of shock waves from major earthquakes as they are transmitted through Earth and scattered

off the core deep in our planet's interior, revealing structures thousands of miles beneath the surface.

Another application to earthquakes was realized when the Big Bear and Landers earthquakes, respectively of magnitude 6.5 and 7.4 on the Richter scale, shook California last June 28. Seismologists had placed a handful of GPS receivers at widely spaced points spanning the North American continent, with an additional cluster of five monitoring stations distributed across Southern California.

The receivers operated around the clock. By staying active 24 hours a day, the receivers reduced uncertainty about the distance separating any two stations on a given day to the incredible figures of just under a quarter of an inch along the horizontal direction and just over half an inch along the vertical.

Continuous monitoring in the five weeks before June 28 showed no changes in Earth's crust. But on the day of the quake, the thousand miles between Penticton, British Columbia, and Piñon Flat, California, suddenly shrank by an inch and a half. Most of that change occurred within Southern California itself, where the separation between receivers at Piñon Flat and Goldstone, only 125 miles north, also narrowed some one and a half inches. For the next two weeks the two stations continued to drift closer by another sixteenth of an inch a day.

GPS gave no indication of a final pre-quake shift that might have warned people of an impending earthquake. But perhaps that forecast ability may someday be possible.

Space enthusiasts used to have to apologize for the high cost of space launches, earnestly explaining the enormous significance of sophisticated spinoffs from space to anyone willing to listen. We all know that the cost of those launches still must be brought down, but GPS should at least make the need to apologize a thing of the past.

—Martin Harwit is the director of the National Air and Space Museum.

Philips Presents The Imagination Machine

For parents who've longed to make television a more positive and involving experience for their

Introducing Something Totally New For Saturday Morning: Quality Programs

kids, Philips introduces the Imagination Machine.[™] The world's first CD-Interactive player.

Since the Imagination Machine is a superb CD audio player you can use it to play all your favorite CDs. And when your kids sit down with the CD-Interactive discs, they'll discover a whole new world of interactive children's programming.

All it takes is one simple connection to your TV.

With the easy-to-use "thumbstick" remote or the optional "Roller Controller" designed for pre-schoolers, your kids take control of everything they see and hear.

The amazing catalog of CD-I children's discs contains lots to see, do and learn. "Paint School," "Brer Rabbit," "Aesop's Fables," and Richard Scarry's "Busytown" are just a few of the CD-I titles designed to bring your children's imagination to life.

And with the new Photo CD technology available through KODALUX Processing Services, you'll have the capability to create your own CD-I family photo albums.

For your own personal demonstration, call **1-800-532-6363**. The Imagination Machine.

Saturday mornings
will never be
the same.



Another First From Philips



PHILIPS

Secretary of the Smithsonian Institution
Robert McC. Adams

Director of the National Air and
Space Museum
Dr. Martin Harwit

Board of Regents
Smithsonian Institution

Ex Officio
Chief Justice of the United States
William Rehnquist, Chancellor
Vice President of the United States
Albert Gore Jr.

*Appointed by the President
of the Senate*
Honorable Daniel P. Moynihan
Honorable James R. Sasser
Honorable John W. Warner

Appointed by the Speaker of the House
Honorable Joseph M. McDade
Honorable Norman Y. Mineta
Honorable William H. Natcher

Appointed by Joint Resolution of Congress
Honorable Anne L. Armstrong
Mrs. Jeannine Smith Clark
Mr. Ira Michael Heyman
Mr. Samuel C. Johnson
Dr. Homer A. Neal
Honorable R. James Woolsey

AIR & SPACE/Smithsonian
Contributing Editors

Michael Beschloss	Nick Kotz
Roger Bilstein	Saunders B. Kramer
Eric Chaisson	W. David Lewis
Tom Crouch	Stephen Maran
David DeVorkin	Laurence Marschall
Ron Dick	Ted Maxwell
Freeman Dyson	Ron Miller
Edward Ezell	James Oberg
Greg Freiherr	Edwards Park
Sylvia D. Fries	Robert E. Pollack
Owen Gingerich	Dominick Pisano
Donald Goldsmith	Fred Reed
Stephen Jay Gould	George Robinson
George Greenstein	Theodore Robinson
William Gregory	Marcia Smith
R. Cargill Hall	Robert W. Smith
Richard Hallion	Jill Tarter
Jim Hansen	Steven L. Thompson
Gregg Herken	Albert Van Helden
Richard H. Kohn	G.L. Verschuur
Nick Komons	Stephan Wilkinson

The V-2

Air & Space is to be commended for "V-2: The Long Shadow" (February/March 1993), in which Tom Huntington covered the horrible story of the German rocket program. What we have had for some 40 years is a gross subversion and distortion of history. Granted, it is debatable whether it was in our nation's best interest to exploit the German rocket experts at the end of the war, or whether they should have been brought before a bar of justice so their acts could be fully exposed. But what ought not to have been taken away was the right of the American people to be fully informed and to render their judgment. Covering up such information was a dangerous tilt toward the kind of society that we had just defeated.

I strongly disagree with Wernher von Braun apologist Fred Ordway, who would have us believe that conditions in the Mittelwerk underground factory and in Camp Dora actually improved "once production began." My reading of the relevant war crimes trial transcripts and other published works, including eyewitness testimony by the camp's liberators, indicates otherwise. Dora was

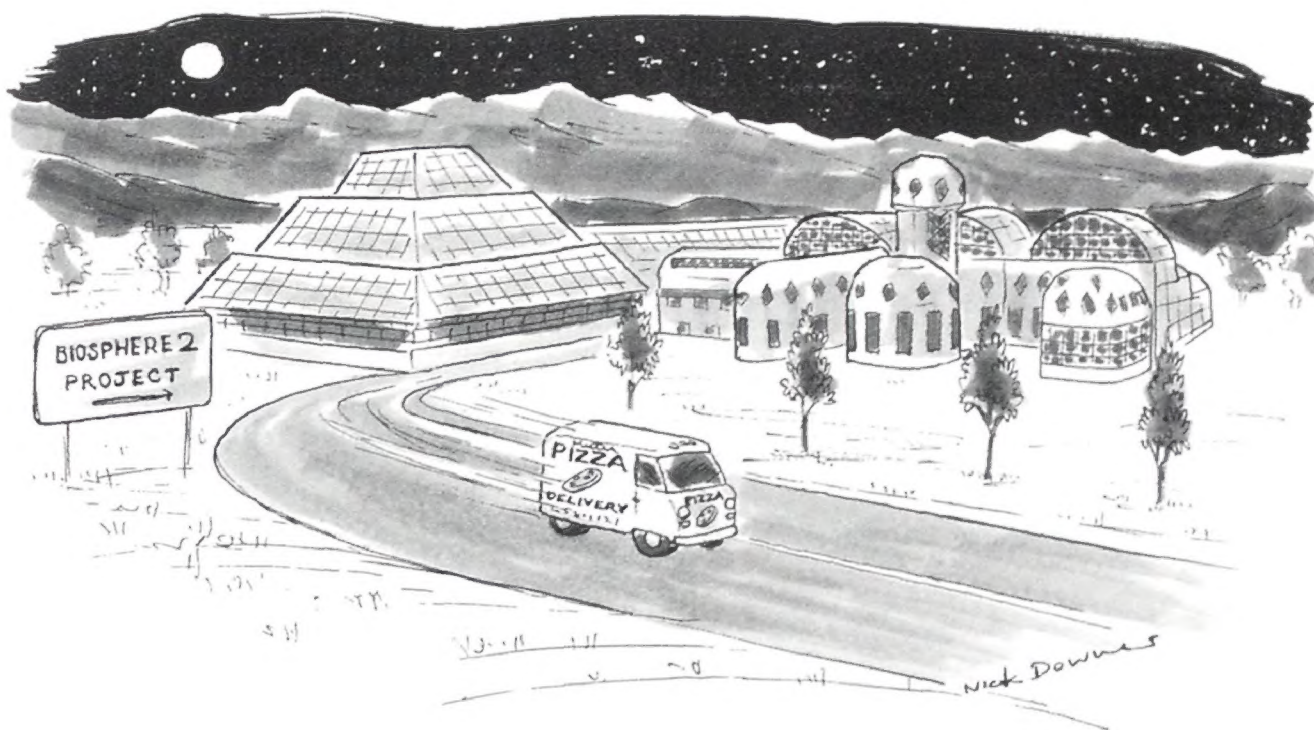
indeed a death camp, differing from the infamous Auschwitz only in that productive labor was extracted before extermination by starvation, maltreatment, or murder. It was not a practice of work *or* die but one of work *and* die. Survival of any prisoners is more likely attributable to the chaos of the Third Reich's final days than to Nazi humanity.

Thanks for a public interest article that was especially timely, considering that new biographies of von Braun are in the works.

Robert Huddleston
Mercersburg, Pennsylvania

I have one vivid picture that Tom Huntington did not take. One bright, early-September day in 1944, as I flew in a B-26 Marauder over the Ardennes forest, I watched what I believe was the first lethal launch of the V-2. As kids today would say, it was awesome. The V-2 emerged from the forest canyon and blazed upward, passing within ten miles of our formation. It climbed higher and higher, trailing a jagged cloud of vapor and smoke.

On return to our base in Essex, England, my aircraft was the first to land.



T H E O F F I C I A L

STAR TREK®

INSIGNIA COLLECTION IN SILVER AND GOLD



To honor the deeds of Captain Kirk and his crew, the original COMMAND INSIGNIA OF THE U.S.S. ENTERPRISE was adapted for use by all Starfleet vessels.

THE COMMAND INSIGNIA OF THE U.S.S. ENTERPRISE

Shown slightly smaller than actual size.

The most prized emblems in the universe, accented in precious silver and gold.

For the first time ever—Paramount Pictures presents the complete collection of interstellar insignias, minted in solid sterling silver and embellished with 24-karat gold.

They are the most prized insignias in the universe. The unmistakable symbols of the major interstellar forces in the universe of STAR TREK and STAR TREK®: THE NEXT GENERATION™

And now, for the first time ever, you can build a complete collection. Authorized and fully authenticated by Paramount Pictures. With each of your 12 insignias minted in solid sterling silver and richly accented with 24-karat gold electroplate.

Some, like the Command Insignia of the Starship U.S.S. ENTERPRISE™ and the noble Vulcan IDIC, are respected and inspirational. Others, like the symbols of the KLINGONS and the ROMULANS, alert all who see them to be wary of their bearers.

You will receive a new insignia every other month, with the issue price of just \$55 each, billed in two equal monthly installments.

SATISFACTION GUARANTEED

If you wish to return any Franklin Mint purchase, you may do so within 30 days of your receipt of that purchase for replacement, credit or refund.

TM & © 1993 Paramount Pictures. All Rights Reserved. STAR TREK and related marks are trademarks of Paramount Pictures.

OFFICIAL SUBSCRIPTION APPLICATION

The Franklin Mint
Franklin Center, PA 19091-0001

Please mail by
Stardate 9331.05
(May 31, 1993).



YES! Please enter my subscription for The Official STAR TREK Insignia Collection, consisting of twelve symbols minted in solid sterling silver, embellished with 24-karat gold electroplate, and sent to me at the rate of one every other month.

I need SEND NO MONEY NOW. Please bill me for each emblem in two equal monthly installments of \$27.50* each, beginning when the first one is ready to be sent to me. The imported hardwood and glass display case, Certificate of Authenticity, and special reference notes will all be provided at no additional charge.

*Plus my state sales tax and \$1.95 per emblem for shipping and handling.

SIGNATURE _____
Mr/Mrs/Ms/Ms _____
ADDRESS _____ Apt # _____
CITY/STATE _____ ZIP _____
TELEPHONE # (_____) _____

15006-6URG/J/M-15



"According to the Navstar satellite, your ball is in the pond."

During the debriefing, one of the intelligence officers asked me how high I thought the V-2 had climbed before it tilted over on its flight to London. I replied: "I don't know. We were at 12,000 feet. It must have been at least at 40,000 feet." The intelligence officer smiled and said: "Don't you know that those things go to 60 miles?" End of interview with dodo pilot!

*Carl Oates
Ashland, Oregon*

Russian rockets and space ventures are hardly ever characterized as being for military purposes, but Germany's are always "responsible for the death of thousands." The Soviets were never called upon to reconcile their holding the free world in terror of destruction for more than 70 years, but the Germans are made to pay daily—ad nauseam—by the media for their five-year war. We are making a very serious mistake in forgiving a potentially dangerous people who can still destroy mankind, while at the same time vilifying a people who have done more than enough to show the world that they can be responsible, trustworthy allies.

*Steven Durcsak
Middle Village, New York*

Geeks No More

"The Einstein Test" by Frank Kuznik (December 1992/January 1993) was generally very good, casting light on an ambitious and fascinating project. However, it briefly touched a nerve. Kuznik describes the project's graduate students as "socially awkward savants...quietly hunched over computer screens." Then he describes the project leader as dressed in "classic nutty professor attire." There is no excuse for an intelligent author to perpetuate these false stereotypes.

In college, my friends and I pursued degrees in astronomy, physics, and engineering, and I can assure you there

wasn't a socially awkward person among us. And when we were hunched over computer screens or just over paper and pencil, it was in an effort to learn. All of the future scientists and engineers I associated with were—and are—fun, well-rounded individuals.

America wonders why it is falling behind in math and science. It's no wonder when people are constantly confronted with the stereotypes of socially awkward students drawn to math.

science, and engineering, as well as the "nutty" professors who teach them. Consciously or unconsciously, such images have the power to turn people away from studying science and related fields.

*First Lieutenant Katie J. Berryhill
U.S. Air Force Reserves
Marquette, Michigan*

Piper Responds

In "Letters" (February/March 1993) you have given Richard D. Norton a soapbox from which to proclaim that Piper Aircraft Corporation was "not interested" in correcting "any design or manufacturing problems" in the Malibu, that when Mr. Norton suggested design changes "Piper didn't want to hear it," and that "Piper could have cooperated and perhaps lives could have been saved." Let me set the record straight.

(1) Piper did indeed blame Messrs. Norton and Rosetti for the wing failure

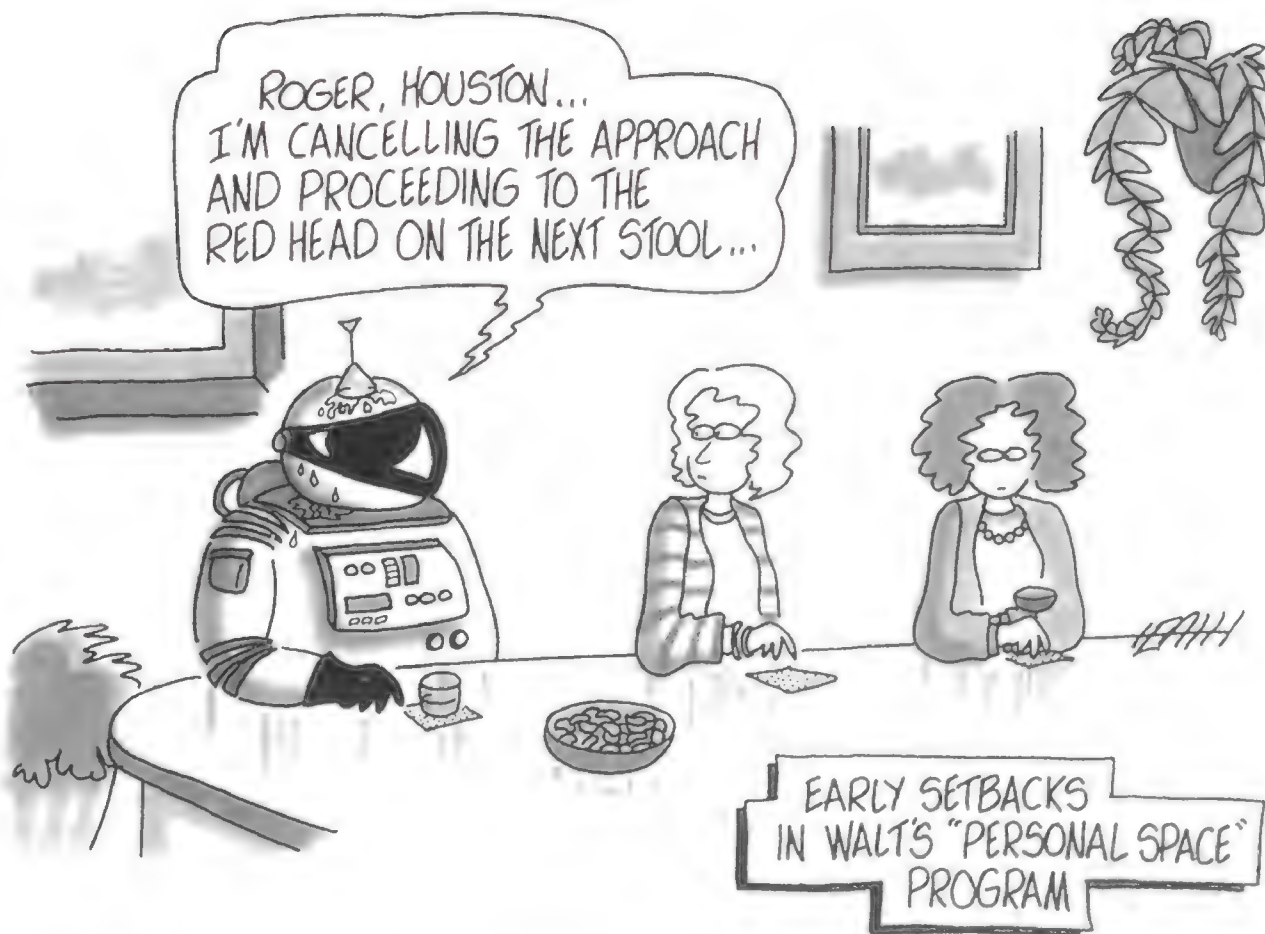


Can you identify the aircraft in this photograph? From time to time the National Air and Space Museum's archives division receives photos that its staff cannot identify. They would appreciate any help in identifying what appear to be coupled engines mounted on a large aircraft. The engines seem to be linked in some way to tractor and pusher propellers on either side, with the blades partly visible. On the back of the original photo are the words "Airplanes, Foreign, Historical" and the partially obscured word "Bodmin" or "Bodmea." If you can solve the mystery, send your response to: Air & Space/Smithsonian, Department ASP, 370 L'Enfant Promenade SW, 10th Floor, Washington, DC 20024.

that occurred during their around-the-world flight. What Mr. Norton failed to mention in his letter is that the flight crew was improperly feeding fuel from a specially installed tank inside the pressurized cabin to the left wing tank. The Malibu has a "wet" wing design in which the fuel is contained within the wing surface itself. When the flow of pressurized fuel from the cabin is not properly monitored it can—and in this case did—cause the wing panels to come apart. The airplane is not certified for normal operation with an auxiliary fuselage fuel tank, although pilots with special flight permits have safely delivered hundreds of Malibus overseas by using these "ferry" tanks.

(2) Piper never ignores suggestions or criticisms regarding its products, particularly when safety is an issue. With regard to the Norton-Rosetti incident, Piper's engineers carefully considered the hypotheses submitted by the pilots' so-called experts and concluded that these theories were "wishful thinking," "incomprehensible," or "completely wrong."

(3) Although suffering from severe cash flow problems and transitioning into Chapter 11, Piper spent in excess of \$1 million assisting the Federal Aviation



Administration in a certification review of the Malibu, begun after a series of Malibu accidents. The results were a matter of public record when you printed Mr. Norton's letter: the Malibu exceeded every structural certification standard, and the accidents were caused by operational mistakes made by the pilots.

Sure, you can always make an airplane stronger, but doing so would have added weight and reduced performance. Does that make the airplane safer? We don't think so. Piper was not willing to "cooperate" with Mr. Norton because we recognized that airplanes must be designed to comply with reasoned federal



The Art of Alan Bean. Conrad, Gordon, and Bean: The Fantasy.
A limited edition fine art print signed by the crew of Apollo XII: Peter Conrad, Richard Gordon, and Alan Bean. \$385

Fine Art That's Out of This World

Any artist can paint pictures of outer space from research, but only one paints from experience. His name is Alan Bean—Skylab II commander, Apollo XII lunar module pilot, and fine artist. One of the ex-astronaut's few regrets is that his senior officer on Apollo XII, Richard Gordon, couldn't join him and Pete Conrad on the lunar surface; someone had to man the orbiting command module. The artist rectifies that situation in his new

limited edition fine art print, *Conrad, Gordon, and Bean: The Fantasy*. Now Dick Gordon stands with Pete Conrad and a mischievous Al Bean on the lunar surface for all to see. Be part of "history that should have been" with this spectacular new print, signed by all the members of Apollo XII. Write or call today for complimentary information and the name and address of the authorized Greenwich Workshop dealer nearest you.

THE GREENWICH WORKSHOP

Please print your name, company information on Conrad, Gordon, and Bean: The Fantasy, by Alan Bean, and the name and address of my nearest authorized Greenwich Workshop dealer.

Name _____

Street _____

City _____ State _____

Zip _____ Phone _____

— "The Art of Discovery" — P361

THE GREENWICH WORKSHOP, INC., 30 Lindeman Drive, Trumbull, CT 06611 • Toll free (800) 243-4246

THE GREENWICH WORKSHOP LTD., 3781 Victoria Park Avenue, Unit 6, Scarborough, Ontario M1W 3K5 • (416) 490-8342 • Toll free (800) 263-4001

standards applying accepted engineering principles.

(4) Also untrue is Mr. Norton's statement that his litigation against Piper "ended quickly when Piper entered Chapter 11." The trial court dismissed his case with prejudice on October 9, 1990, and the appellate court dismissed the appeal on February 14, 1991. Piper did not file bankruptcy until July 1, 1991. Mr. Norton's case ended because he and his co-plaintiffs did not produce evidence to support their claims, not because Piper entered Chapter 11.

Piper is on the verge of emerging from bankruptcy in a case that has been cited by the bankruptcy judge as a model for the way Chapter 11 is supposed to work. Bankruptcy will provide Piper a remedy for the oppressive environment of litigation, exemplified by Mr. Norton's case, which has caused the decline of general aviation.

E. Glenn Parr
General Counsel
Piper Aircraft Corporation
Vero Beach, Florida

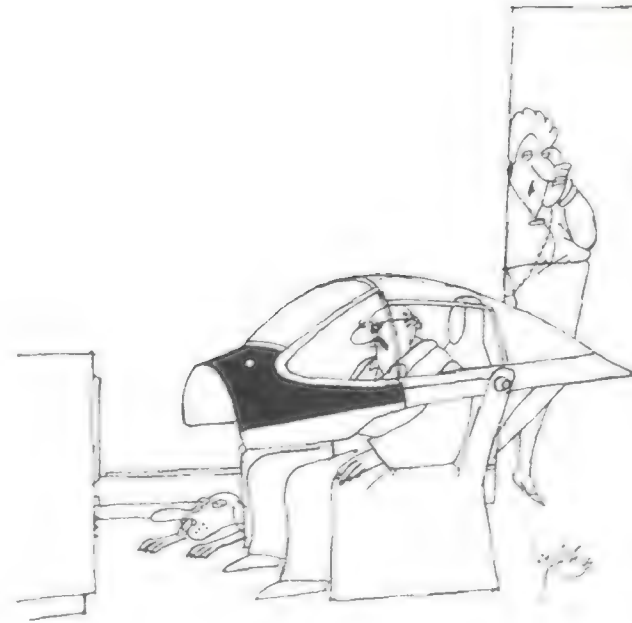
Richard D. Norton replies: The cause of our incident in the Malibu remains undetermined. Our litigation ended because our counsel failed to meet certain deadlines. By the time we sought other counsel to consider further action, Piper Aircraft was indeed in Chapter 11 and we elected not to pursue the matter.

Lose the Cartoons

I just finished reading the February/March 1993 issue. It is great! But when I read articles like "I Came, I Saw, I Lost" and think of all the photo opportunities at Oshkosh, only to find the article illustrated with cartoons—no way! It left me cold! Previous issues have been "illustrated" with cartoons and I had the same reaction. Cartoons are not consistent with the character of this wonderful magazine. If I want cartoons, I'll buy a comic book.

R.G. Sipe
Baltimore, Maryland

I subscribe to *Air & Space* because I have been fascinated with aircraft all my life. To me, aircraft are beautiful things. I like to see them and look at clear photographs of them. Efforts to be creative—artistic—with illustrations in *Air & Space* offend me. It may be that those who see and work with planes every day have become bored with them and wish to enhance aircraft images with interpretive photos and illustrations. I suggest that those bored people find employment elsewhere. The February/March 1993 issue had an article using negatives as illustrations ("An Industry Held Hostage"). That sort of thing is hardly original and certainly does not add to the copy. In the same issue is an article about Oshkosh illustrated with humorous paintings. A lot of work appears to have gone into the paintings, but I would far prefer good clear photographs. I've seen photos of Oshkosh before, of course, but I am not



"He's watching World War II air videos in a mockup of his old P-38 canopy. Yes, I think it's weird."

bored with them. The humorous paintings, however, are childish and cute, and I do not like them at all.

Harold E. Holcombe
Asheville, North Carolina

What an Ag Pilot Is Not

Good grief! After the struggle of our profession to educate our great country about the importance of agricultural aviation, your article "This Is Bobby Yon, Altha Air Service" (August/September 1992) has taken our education efforts a step backward. We have a six-minute video that gives a brief look at ag aviation since its beginning in 1921. Watching it, you'll see no stacks of garbage, no ag pilots crapped out on the couch watching the boob tube, and certainly no burned-out aircraft carcasses.

Tom J. Wood
Publisher, Ag-Pilot International
Mount Vernon, Washington

Correction

General Pyotr Klimuk flew three orbital missions, not two, as reported in "Can Russia's Space Program Survive?" (February/March 1993). Klimuk participated in the successful Soyuz 18B mission, not the aborted Soyuz 18A.

We welcome comments from readers. Letters, which may be edited, must be signed and include a daytime telephone number. Write to Air & Space/Smithsonian, 370 L'Enfant Promenade SW, 10th Floor, Washington, DC 20024. Air & Space is not responsible for the return of unsolicited photographs or other materials.



"Does anyone have a bobby pin?"

SCHROEDER

Fasten your lederhosen.



The V6 Corrado SLC

Hold on to your homburg.
A full-fledged, honest-to-goodness sports car from Volkswagen?
Once you think about it, it makes perfect sense.

We've taken everything you love about German sports cars and all the good stuff about Volkswagens.

The result is the enthusiast's wish list we call the Corrado SLC.

It has a 178-horsepower V6 that is so revolutionary it earned a coveted *Popular Mechanics* Design and Engineering Award.

Plus electronic traction control, ABS brakes and our Plus Axle suspension, which reduces torque steer while improving ride and handling.

So what you have is a sports car that is uncommonly sensible, yet irrepressibly fun.

You'll be glad to know it bears absolutely no resemblance to other German sports cars in one important regard. Its price.

Little wonder *Automobile Magazine* named it one of the 10 best cars in America, saying it is "so good it should carry a Porsche nameplate."

Corrado is built in limited numbers by Karmann Coachworks. So it is unfortunately in short supply.

For details, call 1-800-444-8987.
Or see your Volkswagen retailer.

And test drive Corrado by the seat of your lederhosen.



Experience
Fahrvergnügen

AMROC Bounces Back

Brian Hughes, the boyish, upbeat CEO of American Rocket Company, stood at an amplified lectern set among the sand, scrub, and Joshua trees of the Mojave Desert. Before him were nearly a hundred people from across the country who had congregated here at California's Edwards Air Force Base last January to witness the test-firing of the world's largest hybrid rocket motor—one

incorporating both solid and liquid propellants. Everything looked perfect.

Too perfect. After the countdown stalled at T minus 15 minutes, Hughes grinned sheepishly and told the crowd, "The weather's too nice. We have a five-knot wind requirement, and as of the last reading, it was zero."

Hughes and company postponed the test until the next day, when higher winds

were forecast. Coming on the heels of two previous delays caused by bad weather, this was a fitting symbol for the fortunes of a company that's had more than its share of ups and downs. Since it was formed in 1985, AMROC has test-fired more than 125 rocket engines, but it has also suffered financial misadventures, the accidental death of its first CEO, and an ignominious launch pad disaster that easily could have destroyed the company.

That AMROC was still standing was a testament to the allure of its vision.

Hybrid motors are nothing new. Developed in the 1950s, they were rejected by NASA as too experimental. But hybrids are also cheap, safe, and easy to build—strong selling points now that relatively mundane missions like launching privately owned satellites are becoming the norm. "You don't want to

use a Ferrari to deliver a vehicle to space," says AMROC engineering manager Kirk Flittie. "You want to use a UPS truck."

AMROC's first truck, the DM-01, consists of two chambers—one housing liquid oxygen, the other holding polybutadiene, a solid hydrocarbon fuel—wound around a central combustion port. As superheated LOX vapors flow down the port toward the nozzle, they ignite the exposed and innermost layer of polybutadiene (imagine a candle burning from the inside out).

Because the propellants differ in both location and form, there's no danger of explosion. AMROC unwittingly—though spectacularly—demonstrated this point on October 5, 1989, when one of its H-500 motors suffered catastrophic valve failure. The rocket didn't explode—in fact, the payload was later recovered intact—but the launch vehicle toppled over, engulfed in flames that burned for 24 hours.

In the wake of that calamity, funding dried up. Besides cutting nearly 100 of its 120 employees, AMROC was forced to lower its sights from space transportation in general to propulsion in particular.



CIND SLATTERY

AMROC

Conceived in the summer of 1991, the DM-01 was delivered to Edwards last November. Mounted horizontally on a test stand near Mars Boulevard, the 32- by 6-foot cylinder was supposed to deliver 220,000 pounds of thrust.

On the day of the rescheduled firing, tension in the viewing area escalated as the countdown proceeded. At T minus 12 minutes, Hughes insisted he was "remarkably" calm, but by T minus 4 he was snapping his fingers and tapping his foot in anticipation.

Test director Scott McFarlane came on the P.A. "T minus 5...4...3...2...1...." After a split second that seemed an eternity, a 60-foot plume of flame leapt from the nozzle—the motor looked like the world's largest Bunsen burner. The roar of ignition arrived a fraction of a second later, and even at a distance of several hundred yards the shock wave was powerful.

The burn lasted 15 seconds, exactly as planned. A moment of hushed awe gave way to joyous whooping, hugging, and back-slapping. Up in the control room, behind four feet of reinforced concrete, the reaction was more muted. Designer Bevin McKinney, the only AMROC founder still with the company, was already thinking about the tweaks he wanted to make before continuing the test program. But as he watched replays of the test, the low-key McKinney allowed himself a moment's satisfaction. "You never really know with something like this," he said with a faint smile. "It was like breaking the sound barrier. We had come right up against the threshold but we couldn't get any further. Now we're finally through, and God only knows what lies on the other side."

—Preston Lerner



The Search for Saint-Ex

Nearly 50 years after his airplane went down in the Mediterranean, French author and pilot Antoine de Saint-Exupéry's precise fate remains a mystery. An elaborate effort to find the wreckage of his aircraft, sponsored by a French champagne firm, ended inconclusively last October.

On July 31, 1944, Saint-Exupéry, author of *The Little Prince*, *Flight to Arras*, and *Night Flight*, took off from Corsica in his P-38 Lightning on a photo reconnaissance mission. U.S. radar confirmed that he made it across the hundred-mile stretch

of water to France. But on his return trip the blip vanished from American screens. Due back at 1 p.m., Saint-Exupéry was officially declared lost at 2:30. Historians say it is likely that while reconnoitering

over German-occupied southern France, Saint-Exupéry was downed by a German fighter.

The Louis Roederer champagne house set off "On the Tracks of Saint-Exupéry" last fall with high hopes and great fanfare. It also had help from the flier's friends and family, flight historians, the French Institute for Research and Sea Exploration, and witnesses, including one—17 at the time—who distinctly recalled seeing a P-38 fly overhead near Nice that July day.

Roederer chairman Jean-Claude Rouzaud had been on the track for a year before he revealed his plan to the press last July. "We announced only when we were sure of discovering something," says Rouzaud, whose optimism was buoyed by the extensive research done by historians, aviation and submarine search specialists, and Saint-Exupéry's comrades and relatives. "And we were practically sure of finding, if not [Saint-Exupéry's] Lightning, then three other warplanes or P-38s."

Rouzaud, a pilot and deep-sea diver who undertook the search as a public relations exercise for his champagne house, says that once sonar had located the airplane, minisubs like the *Nautilus*, which filmed the *Titanic*, would descend for a closer look.

But after scouring 60 square miles of the coastline off Nice for two weeks, the project came up empty-handed. "We didn't even find another warplane, which was a surprise," admits Rouzaud. The equipment wasn't at fault, he says; it



Set for transport to the Mir space station this spring is "Cosmic Dancer," a piece of art "designed to investigate the infinite perceptual characteristics of sculpture in the absence of gravity." The contract to put "Cosmic Dancer" aboard Mir is one of the first projects of *Energia Deutschland*, a joint venture of the German aerospace firm *Kayser-Threde* and the Russian firm *NPO Energia* formed to market Russian space services in the West.

The 12-inch-square work was created by Arthur Woods, founder of the *Orbiting Unification Ring Satellite Foundation*, whose charter calls for the introduction of "a cultural dimension to humankind's astronautical endeavors." The sculpture will be evaluated by cosmonauts in terms of the importance of having art integrated into their missions. The foundation's ultimate goal is a reflective inflatable 100-foot version in low Earth orbit.

picked up a slew of echoes. Subs were dispatched each time a return was received. "I went down myself the last time," says Rouzaud, "and found automobile tires." He wants to do more research before meeting with the Institute for Research and Sea Exploration. "We might go again in a year," he says.

Meanwhile, he has issued a call to the aviator's American fans. German radar tracked Saint-Exupéry for about 60 miles during his return trip. No U.S. radar records have surfaced for that leg of the trip. "If the U.S. Army saved its archives from its passage at Borgo, we'd like someone to open the doors for us and find whatever was in the radar room for that period," says Rouzaud. "We really need that information."

—Joshua Jampol

UPDATE

Bad Vibes at Biosphere 2

The 10 scientists charged with overseeing the Biosphere 2 experiment in Arizona resigned en masse last February, citing a lack of cooperation from the project's operators ("Trouble in Paradise," December 1991/January 1992). The crew of eight in the 3.15-acre structure recently had to have oxygen pumped in to compensate for a 28-percent drop that occurred since the ecological experiment began in September 1991.

Globemaster, the Sequel

The Air Force announced last February that the McDonnell Douglas C-17, the military's newest transport, will be named the Globemaster III ("The Name Game," August/September 1992). McDonnell Douglas proclaimed that the recycled appellation "continues a proud tradition of Globemaster transports produced for the Air Force." The C-74 Globemaster I first flew in 1945, and the II was the C-124 transport of the 1950s.

The naming of new aircraft has only recently begun to mimic Hollywood's practice of naming sequels. When the A-10 was named Thunderbolt II, pilots honored the name by ignoring it.

Boosterism

Ads, ads, ads: on TV, billboards, grocery carts, even bathroom stalls. For relief, the ad-sated citizen could at least look to the comforting void of the heavens. Not anymore.

A Conestoga 1620 unmanned rocket, scheduled for a May launch from Wallops Island, Virginia, will be the first U.S. space vehicle bearing a corporate sponsor's message. The Conestoga will place in orbit a service module that will stay up for two years and a recovery system carrying 11 commercial experiments that will parachute back to Earth some 30 days after liftoff. But the Conestoga's mission began before launch. Last March it kicked off an ad campaign for *Last Action Hero*, Arnold Schwarzenegger's latest film.

Columbia Pictures beat out offers from cola, fast food, and athletic shoe companies, among others, for the chance to sponsor the mission. Its ad campaign includes a 900 number that consumers can use to send a message into space. For \$3.50, a caller's voice will be added to one of two CD-ROMs that will be sent along with the payload. Two message-senders will be randomly selected to attend

the launch with Schwarzenegger. Footage of the launch, with "Last Action Hero" emblazoned on the Conestoga, will be used in subsequent ads.

The \$500,000 advertising fee paid by Columbia helps offset the Conestoga's design, construction, and operating costs, which were shared by Westinghouse Electric, EER Systems, and Space Industries. NASA's contribution was far greater: \$85 million in seed money for three launches as part of the agency's Commercial Experiment Transporter program, or COMET, which encourages commercial experimentation in space.

Corporate sponsorship of NASA's own missions would have to clear a variety of Congressional and internal policy hurdles, so you probably won't see a shuttle festooned with logos like an Indy racer anytime soon. But Space Marketing, which arranged the Columbia deal, is looking into other possible promotional tie-ins with the shuttle. Ditto the space station.

According to Space Marketing chief executive officer Mike Lawson, commercialization not only helps defray the vast costs of space exploration, it also helps maintain public interest. Lawson imagines a lunar base with the logo of an electronics giant on the dome. "You won't get to the moon or Mars without commercial participation," he says, "but it's got to be in good taste."

—Lester Reingold

When the Unthinkable Occurs

It seemed like just another panel discussion at just another conference until the slides snapped on screen: color shots of heads, torsos, and limbs piled loosely in blood-soaked cardboard boxes. These were remains of human beings taken from an airliner crash, each needing to be identified. The pictures were so powerful they brought more than 80 otherwise chatty aviation industry officials to an awful silence.

"There's no way to prepare people for what they will see," said Richard Froede, the former armed forces medical examiner who moderated the panel. "Even these pictures are not the same as really seeing it."

The Aviation Disaster Management Conference, held last December in a hotel outside Washington, D.C., addressed issues and situations that airline and airport authorities will face when accidents occur. While other panels raised every topic from the outlining of emergency procedures and training programs to the handling of media inquiries and post-traumatic stress disorder, Froede's panel focused on one of the least studied and most often ignored aspects of disaster management—identifying the victims.

"Almost every airline and airport thinks



END-OF-SEASON SALE. SAVE \$50.

THE OFFICIAL MILITARY ISSUE GENUINE LEATHER A-2 FLYING JACKET

ACT NOW!

A piece of American History is ON SALE!

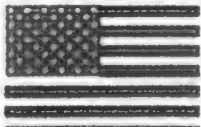
From World War II to Desert Storm, the A-2 Leather Flying Jacket is one of the most famous pieces of battle gear in history. During World War II, the brave pilots of the U.S. Army Air Corps relied on the A-2 for protection and comfort. The A-2, updated to current military spec's, was worn by our U.S. Air Force pilots in the Gulf War, too. Lightweight and comfortable yet "tough as nails," the A-2 identifies its wearer as one of an elite, brave breed of fighting men. And now, for a limited time, you can acquire the A-2 for only \$199,* that's \$50 off regular price.

Genuine Military Issue.

Not a Commercial-Reproduction.

Now, you can own the very same A-2 Flying Jacket issued to U.S. Air Force pilots.

MADE IN



U. S. A.

The jacket you receive will be made in the same factory by the same American workers who produce the A-2 Jacket for the U.S. Air Force. *Not a reproduction and not a look-alike copy — this is the*

genuine article! Available exclusively from Willabee & Ward.

Proudly Made in the U.S.A.

The A-2 Flying Jacket is made in the U.S.A. using materials and production methods specified by the U.S. Air Force. Premium goatskin ensures ruggedness and great looks. Knitted cuffs and waistband and a spun cotton-blend lining ensure draft-free comfort. Details include regulation snap-down collar, shoulder epaulets, and roomy snap-close pockets. You'll also receive a certificate of authenticity stating that yours is a U.S. Air Force A-2. Battle-proven and built for long life, the A-2 Flying Jacket actually gets better-looking with age.

Save \$50 Off Regular Price.

Payable in Convenient Monthly Installments.

The A-2 Leather Flying Jacket — normally \$249 — can be yours for just \$199,* payable in five convenient monthly installments of \$41.70 charged to your credit card. Your satisfaction is guaranteed. If you are not completely delighted with your jacket, simply return it in original condition within 30 days for exchange or refund. Take advantage of this remarkable end-of-season sale. Order today. Available in sizes 34-52 regular and long. Call about larger sizes (to 60) available for \$50 more. (For best fit, order one size larger than your normal jacket size.)



SALE!
Only
\$199*

Accept no substitutes!

This is the actual Leather A-2 Flying Jacket supplied to the United States Air Force.

Have questions about sizing? Call us - we'll fit you over the phone. Quantities are limited, so call now!

Phone orders normally shipped next business day.

* Plus \$9.50 shipping/handling.

CALL TOLL-FREE: 1-800-331-1858 EXT. 636-454

Willabee & Ward
47 Richards Avenue
Norwalk, CT 06857



Satisfaction Guaranteed

CALL TOLL-FREE: 1-800-331-1858 EXT. 636-454

Please send me _____ Genuine Leather A-2 Flying Jacket(s).

Size (Even sizes 34-52): _____ ☐ Regular ☐ Long

Charge each of 5 installments of \$41.70** to my credit card.

☐ MasterCard ☐ VISA ☐ Discover ☐ Am. Ex.

Credit Card # _____

Exp. Date _____

Name _____

(PLEASE PRINT CLEARLY)

Address _____

City/State/Zip _____

Signature _____

(All orders subject to acceptance.)

☐ I prefer not to use a credit card and will pay by check. Enclosed is my check for \$199 plus \$9.50 shipping/handling, a total of \$208.50.**

**Applicable sales tax, if any, will be billed with shipment. Higher shipping/handling outside U.S.

THE MEMPHIS BELLE



500 s/n

\$150 + S/H \$3.50

Overall print size 19" x 27"
Image size: 15 1/2" x 23 1/4"

Nationally acclaimed artist Kent Sullivan captures the "Memphis Belle" as she completes her final mission. Sullivan's renowned works are part of NASA's "Visions Of Flight" world tour. Each print is countersigned by WWII pilot General Ret. Pete Quesada.

To order your fine art print send check or money order to:

PRESTIGE IMAGES
P.O. Box 504
Hastings, NE 68902-0504
(402)-463-0319

Fifty Artist Proofs are included in this edition @ \$180



Change the Course of Aviation History

TIGHAR (pronounced "tiger") is the dynamic non-profit organization for everyone who believes that rare aircraft are worth finding and saving.

Joining TIGHAR puts you at the forefront of aviation archeology and historic preservation.

As a member, you'll have the opportunity to participate in expeditions, seminars and research projects that are changing the course of aviation history.

You'll also receive the foundation's widely acclaimed newsletter, *TIGHAR TRACKS* and project updates.

Membership in TIGHAR is \$35 for one year, \$60 for two years, or \$125 for five years. Send a tax-deductible contribution or write for a free information packet to:



TIGHAR
Department SAS
2812 Fawkes Drive
Wilmington, DE 19808 USA

SOUNDINGS



En route to Jupiter after its second gravity-assist sling around Earth, the Galileo spacecraft sent home a postcard last December. Taken from a distance of 3.9 million miles, this computer-enhanced image shows the moon, its far side facing the sun, as it moves from left to right in Earth orbit. Antarctica can be seen through the clouds shrouding Earth's southern hemisphere.

it's never going to happen to them," said panelist Jay Levinson, superintendent of victim identification for the Israel National Police. "When it does, they're completely unprepared."

In the first three days following the 1988 explosion over Lockerbie, Scotland, more than 40,000 people phoned the on-site authorities to find out if someone they knew had been on Pan Am Flight 103. "How are you going to answer those calls when it happens to *you*?" boomed Levinson.

Identifying bodies is simultaneously simple and complex. "You take ante-mortem information and compare it with post-mortem information, and if you get a positive comparison you have a positive I.D.," Levinson said. "But how many of you know what information to collect?"

The usual forms of identification are, by themselves, pretty useless. People don't always carry their own credit cards or driver's licenses. Nor do they always travel under their real names, so passenger lists are of limited value. Given the generally unrecognizable state of the

victims, photo IDs are hardly conclusive. And even if the remains are viewable, a visual identification by a relative is at best suspect, since emotional trauma can often make people think they're seeing something or someone that they're not.

"Fingerprints, dental records, and medical records," Levinson iterated. "That's what you want." Airports and airlines should have plans in place to assist pathologists in collecting that data. They also need to know well in advance where they will establish the triage area and the mortuary. "Identification is a process that begins long before the actual disaster," Froede said.

When the lights came up and questions were called for, an official from San Francisco International Airport broke the silence by commenting, "I thought that with all we've done with our emergency planning that we were prepared. I see now we've only scratched the surface."

Bert Ammerman, who lost his brother over Lockerbie and at one point served as president of Victims of Pan Am Flight 103, explained that authorities can help families by being as prepared as Froede and Levinson had suggested. "I lived the horror and shock they just talked about," he said. "It took 10 days to identify my brother."

It's not just that failure to properly and quickly identify victims can, as Froede put it, land you in court. "People need closure," Ammerman said. "If family members need to see autopsy photographs for them to be sure, don't let some policy against it stand in the way. You're dealing with human beings. Seventeen bodies were never identified at Lockerbie. Some of those families are still under psychiatric care."

—William Triplett

UPDATE

Barber vs. Lanphier vs. Yamamoto

Air Force Secretary Donald B. Rice decreed last January that there shall be no change in the credit for the downing of the Mitsubishi bomber that carried the commander of Japan's World War II fleet ("Who Shot Down Admiral Yamamoto?" February/March 1992). Despite the efforts of the Second Yamamoto Mission Association to credit Rex Barber for the kill, the Air Force Board for Correction of Military Records maintains that Barber must share the credit with the late Tom Lanphier.

NORDICTRACK'S FITNESS BIKE "BEST OF WHAT'S NEW!"

— POPULAR SCIENCE



- Revolutionary reflex-action radial gear shifts more easily and eliminates over 100 parts!
- Patented power-response rim band brake provides three times the braking power of ordinary bikes!
- A virtually maintenance-free design keeps you on the road and out of the shop!



- Adjustable seat and handlebars and exclusive upright seating offer maximum comfort and safety!
- Unique frame geometry and a shorter wheelbase offer a high level of stability and maneuverability.

Introducing NordicTrack's Fitness Bike™ — the only bike designed for fitness. This revolutionary bike is so innovative, it was the Grand Prize winner (recreation category) of the 1991 "Best of What's New" award from *Popular Science* magazine. Call today to road test the safest, most comfortable and easy-to-use bike you've ever ridden.



OPTIONAL INDOOR FITNESS STAND GIVES YOU BIKING ENJOYMENT ALL YEAR ROUND!

Take advantage of three satisfaction guarantees you won't find at your local bike shop:

1. 30-day home trial.
2. Two-year warranty.
3. Toll-free Customer Satisfaction Hotline.

CALL TODAY FOR FREE BROCHURE AND VIDEO:

1-800-858-BIKE Ext. 9Y0D3

© 1993 NordicTrack, Inc., A CML Company • All rights reserved.

FOR MORE INFORMATION, WRITE: NORDICTRACK, DEPT. 9Y0D3

104 PEAVEY ROAD, CHASKA, MN 55318

☐ PLEASE SEND ME A FREE BROCHURE

☐ ALSO A FREE VHS VIDEOTAPE

NAME _____

STREET _____

CITY _____

STATE _____ ZIP _____ PHONE () _____

NordicTrack's **FITNESS BIKE™**

OTHERS HAVE TRADITION.
WE HAVE THE FUTURE.



rotiring 600 is the epitome of quality and precision styling. Fountain pen, ballpoint, rollerball, trio-pen and pencil. Matte-black or silvertone finish. Also with gold accents and fountain pen with 18-karat gold nib.



rotiring

KOH-I-NOOR INC. • Exclusive North America Distributor • (800) 877-3165

The Best Laid Plans



A baby space station for rhesus monkeys was to orbit 200 miles above Earth and provide scientists the opportunity to study the effects of prolonged weightlessness in advance of manned missions.

The traveling exhibit "A 'Blueprint for Space' from *Collier's Magazine*" celebrates the words and images that helped transform space travel in the popular mind from fantasy into reality. The core of the exhibit, opening in the National Air and Space Museum's art gallery on May 5, is a treasure trove of paintings and drawings from a series of articles published in *Collier's* magazine in the 1950s. Written by Wernher von Braun and a handful of other space scientists, these articles gave Americans their first look at space exploration as a real and present opportunity.

I saw the exhibit at the IBM Gallery of Science and Art in New York City, where the organizers had included clips from three films produced by Walt Disney studios for the "Tomorrowland" TV show. It was a rare treat to see these and so many of the now-

famous *Collier's* illustrations—by artists Chesley Bonestell, Fred Freeman, and Rolf Klep—in one place. Together they convey the remarkable rationality of von Braun's plan for stepping outward from Earth. Some of the drawings still display von Braun's penciled comments to the artists. There are even a few sketches by von Braun himself, which help to show how the design evolved.

Comparing this elegant plan—with its three-stage booster, wheel-shaped space station, lunar base, and winged Mars lander—with the fits and starts of space projects over the last 20 years left me



The second pair of *Collier's* articles illustrated Wernher von Braun's ideas for lunar exploration: a cargo ship and two passenger craft, assembled in the vicinity of a space station, would journey to the moon for a six-week mission.

nostalgic for the optimism of Eisenhower-era America. I left the exhibit thinking, "God, I wish it had happened that way."

—Andrew Chaikin

Crazy Like a Fox

Herb Kelleher, president, CEO, and chairman of the board of Southwest Airlines, is standing on the steps of the National Air and Space Museum with a Wild Turkey and water in one hand and a Merit Ultra Light in the other while rain lashes Independence Avenue. "Sometimes when I get off a long flight I light up three at once!" says Kelleher, who punctuates every sentence with an exclamation point. "I flew from Dallas to Boston last week and that last half-hour just about killed me!"

Kelleher has escaped a non-smoking

cocktail party in the Museum that is preceding the General Electric Aviation Lecture titled "Just Plane Smart," in which he will reveal how Dallas-based Southwest, with its fiercely loyal customers and consistent profits, has become something of a cult in Texas and an anomaly in an industry that has, as Kelleher points out, lost \$7 billion in the last three years. Kelleher is the only airline executive who has spoken in this lecture series, which has run at the Museum for the past 11 years featuring mainly the adventures of World War II veterans. Curator Peter Jakab, who has been selecting the speakers, says he's attempting to broaden the scope. This year aerobatic pilots and Desert Storm veterans joined the Doolittle Raiders, WASPs, and Chuck Yeager. "I chose Herb Kelleher because he's charismatic," Jakab says. "He's also one of the few who's been able to make a regional airline succeed rather than being gobbled up by the majors."

But that's business talk, and right now Kelleher would rather smoke, drink, swap jokes with the GE guys, and banter with the guests who are arriving to hear him speak. "You've come to see me *again*?" he tells one admirer. "You're a glutton for punishment!"

Kelleher opens the lecture by noting that one also has to be a glutton for punishment to want to run an airline in these hard times. "It takes nerves of steel simply to remain neurotic!" he says. "You have to look at the airline business as just a hobby!"

An ex-lawyer from New Jersey with a big grin and a shock of silver hair, Kelleher pursues his hobby with great glee. He founded Southwest in 1967, and, by using what *Time* magazine describes as a "starkly simple formula," he has made it a model of profitability. "Doing things differently," Kelleher says, is the key. "The financial community thought we would be road kill unless we imitated other carriers. If it's conventional, it ain't wisdom!"



SMITHSONIAN INSTITUTION

ARTIFACTS



MUSEUM OF AMERICAN HISTORY

A reverence for tools is obvious in this carefully built and decorated Japanese tool box, part of the Museum's collection of working artifacts at the Paul E. Garber Restoration, Preservation and Storage Facility. The Museum owns eight aircraft tool sets from Germany and Japan, part of the plunder the U.S. Army Air Corps collected during World War II. Most of the boxes hold around 50 tools and weigh between 80 and 90 pounds. Some of the tools pictured were used in the restoration of the Seiran, a Japanese seaplane (see In the Museum, April/May 1991).

Southwest is the definitive no-frills airline. It flies only Boeing 737s to cut maintenance and training costs, its flights average an hour and require no meals, and seating is first come, first served, an arrangement that cuts turnaround time to about 15 minutes, which means more time in the air (making money) and less time loitering at the gate (losing money). It doesn't "interline"—exchange passengers and baggage with other airlines—because "that would be an intrusion on our efficiency," Kelleher says.

He describes his company philosophy as "innovation through inertia." "It's our specialty; we don't do anything, and things just go right for you as a consequence. That's the one I'm proudest of because sometimes in our business it's hard to remain as sluggish as you need to be." Nonetheless, Southwest has had a few tricks up its sleeve. Kelleher recalls the time a competitor undercut fares, causing Southwest to counter with an offer to fly passengers at the lower fare, or twice that in exchange for a bottle of Chivas Regal. "We became the largest liquor distributor in Texas for three months!"

Kelleher works the crowd for about an hour, then answers the audience's good-natured questions. "What's your opinion of high-speed rail?" "Gussied-up prairie schooners!" Kelleher declares. On safety: "Customers would rather not crash if they have an alternative." "Does Southwest still

aspire to be Ali McGraw?" The chairman guffaws. "Back then we did want to model ourselves after her—you know, modern, pert, with it, quick-witted," he says. "And today I still get letters saying, 'You're the first airline I've flown in 20 years that has a personality!'" It's obvious where all that personality comes from.

—Patricia Trenner

Museum Calendar

Except where noted, no tickets or reservations are required. To find out more, call Smithsonian Information at (202) 357-2700; TDD: (202) 357-1729.

April 3 Monthly Sky Lecture: "NASA, Robots and the Inferno." Dave Lavery, NASA Office of Advanced Concepts and Technology, will explain the mission of Dante, the robot that explored Mount Erebus in Antarctica. Einstein Planetarium, 9:30 a.m.

April 13 Exploring Space Lecture: "The Role of the Amateur in Astronomical Discovery." David Levy, columnist for *Sky and Telescope* and an amateur astronomer who has found seven comets, will describe the sport of hunting for new objects in the sky. Einstein Planetarium, 7:30 p.m.

April 22 General Electric Aviation Lecture: "Stealth and Desert Storm." Colonel Ralph Getchell will recount his experiences as an F-117A pilot. Langley Theater, 7:30 p.m.

May 12 Exploring Space Lecture: "Optical Telescopes for the Millennium." Frederic H. Chaffee, the director of the Multiple Mirror Telescope Observatory in Arizona, will trace the development of optical telescopes. Einstein Planetarium, 7:30 p.m.

May 18 Items from General Curtis E. LeMay go on display at the Paul E. Garber Restoration, Preservation and Storage Facility in Suitland, Maryland. The items include flight apparel, 30 medals, two flags, and two home movies.

May 20 Charles A. Lindbergh Memorial Lecture: Congressman Randy "Duke" Cunningham, one of the most highly decorated pilots in the Vietnam War and a former commanding officer at the Navy Fighter Weapons School, will speak about the challenges military pilots face. Langley Theater, 8 p.m.

Museum Visits For a free planning packet, write Smithsonian Information, Smithsonian Institution, Washington, DC 20560, or call (202) 357-2700. Daytime parking near the museums is limited.

THE CONDOR AND ME

In the 1930s my family lived in the shadow of Central Airport in Camden, New Jersey. At night I went to sleep watching the light from its beacon make unending trips around my bedroom walls. We played a guessing game at dinner: identify the airplane by its sound as it flew over our neighborhood on final approach. By the time I was six years old, I rarely missed.

Sandy and primitive, Central Airport was caught between the twilight of the biplane age and the era of the great silver fleets. Weeds grew through the cracks in the asphalt runways, and sand that blew over from the banks of the Delaware River got caked with oil and grimy perspiration from hot radial engines. A couple of times a week my dad drove us to the airport to see the airplanes and the pilots, heroes with weathered faces, leather helmets, and glass goggles. It was on one of these trips to the airport that I got my first look at a legend.

The year was 1937, and Clarence Chamberlin, the celebrated transatlantic flier, was barnstorming the country, selling rides in his gigantic biplane, the 1929 Curtiss Condor 18. One dollar would get you airborne with the first American pilot to fly a passenger across the Atlantic Ocean. But your aircraft would be nothing like the small, graceful Bellanca, *Columbia*, that Chamberlin flew from New York to Berlin two weeks after Lindbergh's historic flight to Paris. Everything about the Condor, the civil transport version of the Curtiss B-2 heavy bomber, was clumsy and massive. The first time I saw it on the ground, the Condor impressed me as a weird assortment of wings and engines, struts and wires, with wheels that seemed almost as tall as my dad. I wasn't sure I was ready for a flight in it, even if the pilot was Clarence Chamberlin.

The huge radiators that grew out of the top of the two 600-horsepower Curtiss Conqueror engines were as imposing as battlements. Standing at least four feet above each engine nacelle, they looked like giant gasoline drums, ready to



His airline never did materialize, but Clarence Chamberlin introduced thousands of people to flight with ten-minute hops in the Curtiss Condor 18.

explode at the slightest spark. Twenty-foot-long nacelles dominated the lower wing. The large rectangular entrance that swallowed passengers into the dark interior was a stark, unfriendly hole in the canvas-covered fuselage.

The very name of the airplane evoked the vision of a great flying beast that craved your flesh and bones. Still, I had known other children—my older brother for one—who had flown in it and survived. Roaming the warm sunny skies up north in the summer and migrating south in the winter, dropping into pastures and scruffy airfields, the old bird searched the cities and farms for kids in imitation leather aviator helmets. We were not hard to find. Our anxious faces always turned skyward when the drone of an engine broke the silence.

It wasn't until the following year, when I was seven, that I found the courage to board the Condor. Times were hard in 1938, and my dad, a handsome traveling salesman with a velvet voice, sweet-talked

someone into giving my sister and me a ride together for 50 cents. Standing near the barker at the door of the airplane, Dad waved for us to come out of the crowd. As we moved up the walkway, the barker announced over the loudspeakers, "Ladies and gentlemen, these two children will be riding with Colonel Chamberlin for just 50 cents." I cringed, my dad smiled, the crowd clapped appreciatively, and the Condor loomed in front of me. My sister, nine years old and knowing a good deal when she heard one, had already clutched my hand and started racing toward that dark hole in the airplane's side.

We scampered up the stepladder and through the doorway, then sat down side by side on the long wicker seat that ran the length of the fuselage. We were the last of 27 passengers to board; maybe that's why we got on for 50 cents. Times were tough for Chamberlin too.

Seated in the last seat near the doorway, we were looking through the

window when the left engine bellowed to life, sending sand and grass flying through the air and thunder through the cabin. With nothing but fabric between us and the wind, it was like being in a tent in a hurricane. The opaque cloud of swirling exhaust turned the window into a mirror, smudged with nose and hand prints, revealing the faces of two children startled to realize they were about to leave the ground.

This airplane wasn't meant for discriminating passengers who placed a premium on comfort. Although Curtiss built the Condor 18 as an airliner, Chamberlin had been forced to make a few alterations when it became clear that his vision of establishing a new air service between New York and Boston was a little ahead of its time. He had planned to undercut American Airlines, whose fares on that route were \$13.90 one way and \$25.02 for a round trip, but American prevailed. Growing desperate for cash, Chamberlin advertised get-acquainted airplane rides for a dollar and discovered that thousands of people who could never afford the \$25 for a flight in the last lean years of the Depression were happy to chip in a buck with 26 other people to fly with the famous aviator.

To meet the great demand for passenger seats, Chamberlin took two Condors back to his old Crescent airplane factory at Teterboro Airport in New Jersey and converted them from glamorous airliners to stripped-down barnstormers. He ripped out seats, partitions, the

washroom—anything that added unnecessary weight, including the sound- and shock-absorbing materials that lined the cabin. Wicker seating for 27 was squeezed in the space that once held 18 high-back adjustable leather seats. As a final insult to its airliner image, the words "FLY \$1.00" were painted on the undersides of the wings.

The second engine announced its presence with another deafening roar, and soon we were rumbling down the taxiway, the airplane struggling under its heavy load. As we drew close to the runway, wild enthusiasm turned to trepidation and the passengers gripped the seat and each other in anticipation of the takeoff. Chamberlin started the roll, and the windstorm that would be with us throughout the flight made



us unglue our hands from our seats and plaster them over our ears.

The noise in the cabin made conversation almost impossible. I shouted directly into my sister's ear: "LOOK HOW LITTLE THE PEOPLE ARE, MARIAN!" "HEY, THERE'S THE RIVER!" "LOOK

AT THE TINY CARS!" Despite the somewhat alarming sound of wind beating on the fabric beast, the Condor's massive wings were a comforting sight, majestically hauling more than eight tons of airplane and spellbound passengers through the air.

The Condor had a generous supply of windows, and the slow cruise at 115 mph was perfect for sightseeing. The ride was only about ten minutes long, but that was enough time to spot familiar roads and to take in for the

first time the patchwork of greens and browns. If you were lucky, you flew over your neighborhood and picked out your house—and hoped your neighbors were watching from below. If you were a kid who flew in Chamberlin's Condor, you got some respect from the neighborhood gang.

Chamberlin flew us over the Delaware River bridge, and when I saw this new altitude reference drifting under the wing, fear turned my legs to jelly. I recovered enough to imagine that we were on a perilous bombing mission, with the bridge an enemy's supply route. Target in the crosshairs, bombs away, then back to Central Airport.

The world grew larger as we floated back to Earth, and soon the giant wheels touched the runway at the stately speed of 50 mph. Twenty-seven slightly deafened people stumbled out of the dark interior of the Condor and into the sunlight, grinning and still shouting at each other. In 1938 it was fashionable to walk around for a day with ears ringing and a smirk on your face that told the world you had just been up in an airplane.

Until I started taking flying lessons nine years later, that was my only flight. Meeting the Condor had been like kissing an ugly relative; the experience taught you to find a better hiding place the next time the visitor was in the neighborhood. But the landscape that Chamberlin showed me and thousands of others when I was seven years old was a miniature garden of people, houses, roads, and rivers—a peaceful, pretty picture. Everyone, no matter how old, deserves that barnstormer's view, if only to pretend for those ten brief minutes that the world is as serene as it appears.

—Louis Arata

Before its barnstorming career, the Condor offered its 18 passengers elegance if not a particularly quiet ride.



Potty Training

How do you go to the bathroom in space? The question strikes fear in the hearts of bashful astronauts. Everybody asks. In fact, it's the title of the "everything you ever wanted to know about space" book by Skylab astronaut Bill Pogue.

Apollo astronauts, who wore diapers and defecated into plastic bags, ran a risk of bacterial infection due to a rudimentary disposal method. Shuttle crews are lucky, I guess, to have a sophisticated latrine. But the technology is far from perfected, and plumbing breakdowns are a major concern. "If the toilet stops today, you come home tomorrow," says veteran astronaut Bonnie Dunbar.

As a reporter, I had trusted astronauts who said using the shuttle potty was like going to the bathroom in a Winnebago. But curiosity got the best of me when auditors recently accused NASA of flushing money down the drain of a new, improved toilet. According to the General Accounting Office, the space john that first flew last January cost \$30 million—nine times the original estimate. What was there about this privy, I wondered, that could possibly cost so much?

Sharon Jones, who teaches potty procedure to the astronauts, agreed to show me. The waste collection system, as NASA calls it, sits in the Johnson Space Center's Building 5, along with most of the other shuttle simulators. Jones leads me down a long, narrow hallway. Suddenly we seem to be backstage at a theater, surrounded by brown drapes and a clutter of props. The bathroom is about 10 feet by 10 feet, but the toilet stall is the size of a broom closet. Jones is showing me the eight plastic urine funnels when I notice my reflection in a Mylar square on the wall. "This is our rear-view mirror," she deadpans, then explains that this allows you to check for a "good seal" between your equipment and theirs.

The toilet itself is a tank with a white seat, a baby-blue urine hose, and thigh and foot restraints. Jones turns on a switch and the toilet whines like a jet engine. The noise comes from a fan system that draws a vacuum inside the tank and separates the

urine from the air by centrifugal force. She clips a urine funnel to the hose and sucks on her hand with it. "If they've got good air flow, they do their business; clean their urinal cup, stow it, and turn the WCS off," Jones says.

A bowel movement takes a good bit longer. You sit down, strap your heels into stirrups, and swivel a padded bar over each thigh. Once the toilet hits a steady high pitch, you push a lever that opens a door beneath the seat. High-pressure blasts of frigid air take the place of water and gravity to carry solid waste into the bowl. It's like sticking your derriere in the refrigerator.

An astronaut's first exposure to the shuttle potty is a "positional trainer," which sits beside the working mockup and faces a TV screen. A sign on the wall gives instructions. "Sit down on the trainer and spread buttocks," it begins.

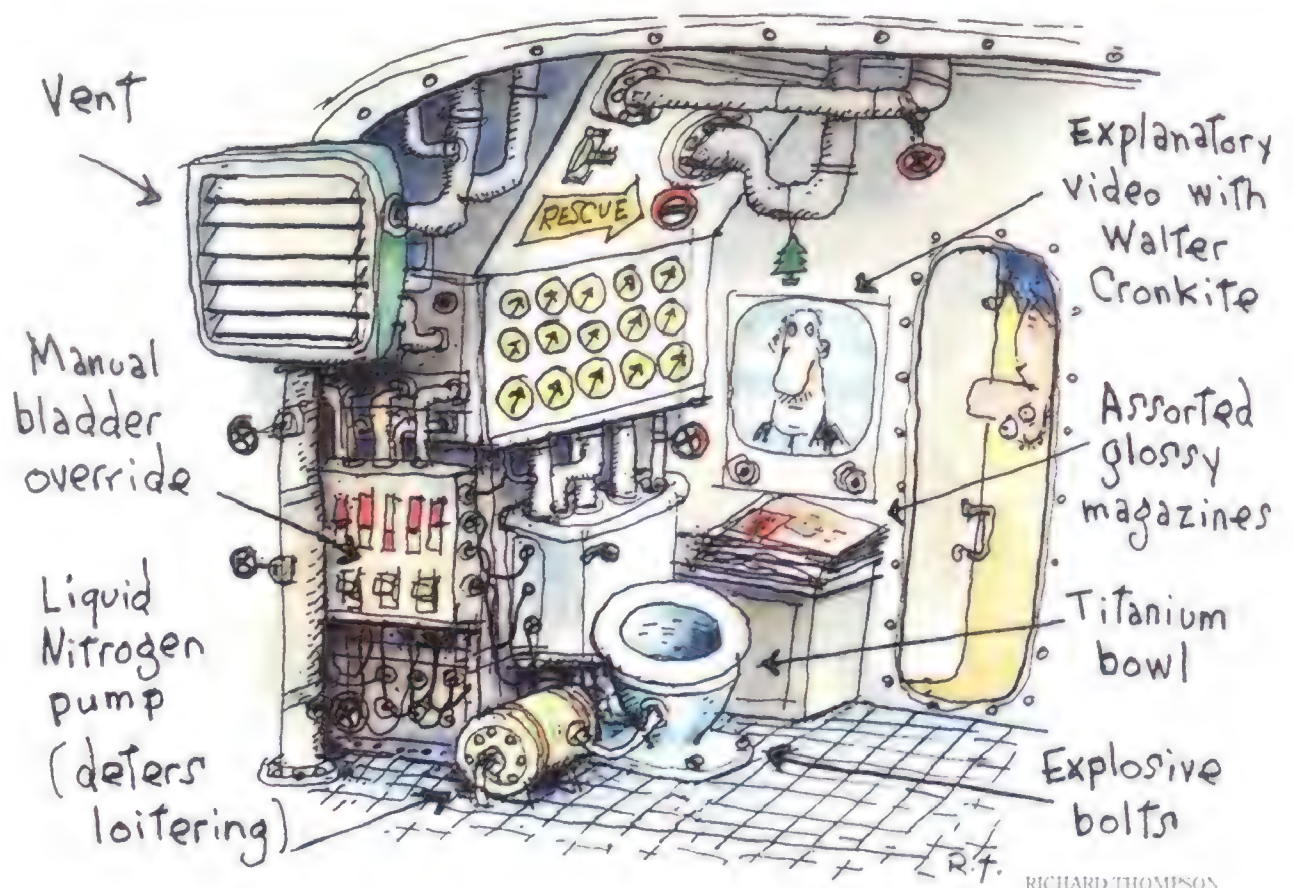
"There's a light down there," I observe as I peer into the six-inch hole. Actually, there's a whole video camera. "Hit picture control," Jones says, "and at this point in time you would be able to see where your correct body positioning is." What you see

on the TV screen is, well, what you see. "It's a unique perspective," Jones allows.

The seat, with its exaggerated contouring, is uncomfortable. I sit cockeyed, sloped forward with my knees higher than normal. Jones says she doesn't really care if I'm comfortable as long as I can see that I've taken proper aim and can remember what my position feels like. "The better you aim, the less you have to clean up," she says. She pulls out "what we call a contingency scraper tool." It looks just like the 79-cent plastic spatula in my kitchen drawer, except I bet NASA paid plenty more to get one with an aluminum handle. The spatula is used for scraping feces away from that six-inch hole, which NASA calls a transport tube.

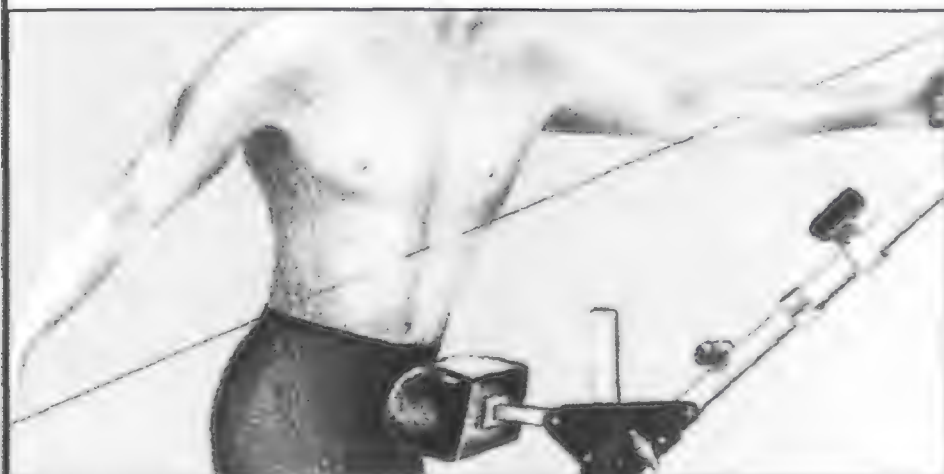
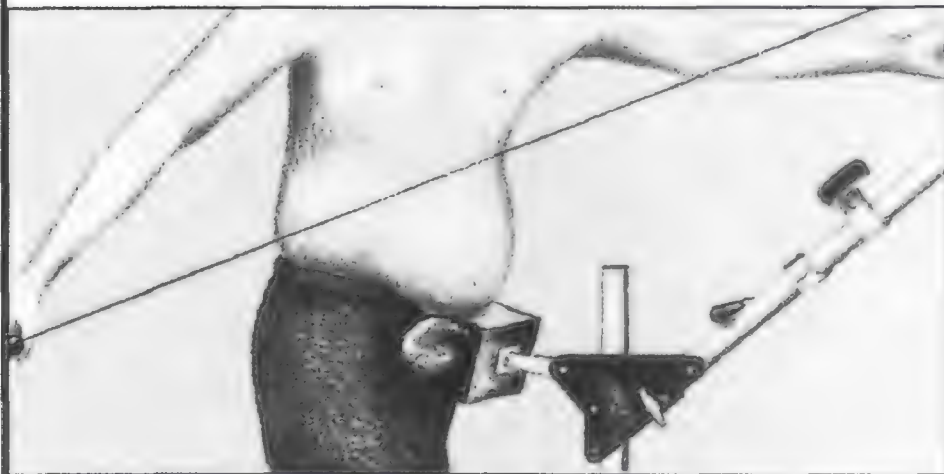
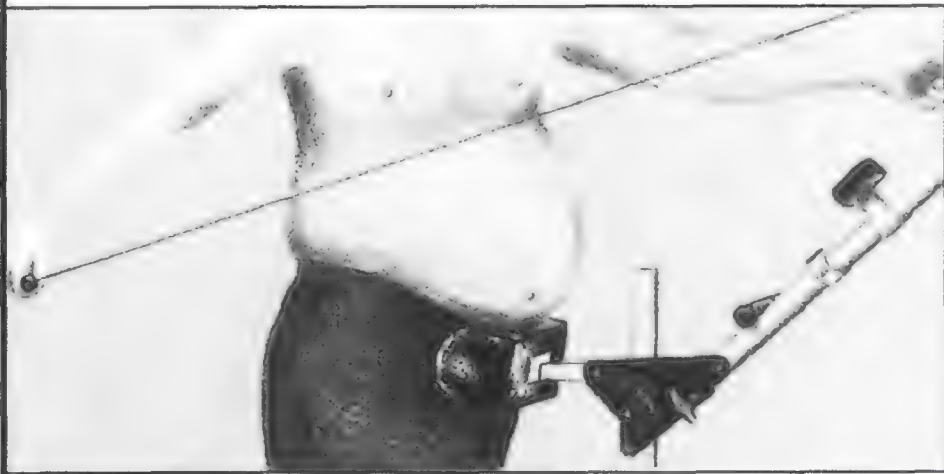
People who haven't been to space take certain things for granted. Extraterrestrial toilets have to compensate for the lack of gravity when the body performs its most down-to-Earth function. So if anything on the shuttle has to be 900 percent over budget, it might as well be the toilet. You can't just flush and forget it.

—Beth Dickey



RICHARD THOMPSON

The best way to a man's stomach...NordicTrack.



"The World's Best Aerobic Exerciser".

With a NordicTrack you can burn more calories in less time than with most other kinds of exercise machines. Up to 1,100 calories per hour, according to fitness experts.

Meanwhile you can strengthen your heart, tone your muscles and improve your stamina.

NordicTrack simulates the motion of cross-country skiing, the most efficient and effective way to get exercise.

A NordicTrack® workout helps you lose weight and keep it off. It's more effective than dieting. And it's a lot less stressful on the body than high-impact sports.

This is the way to look as good as you feel.

NordicTrack boosts your productivity and creativity and lowers your stress, all while helping you lose weight.

A NordicTrack exerciser provides a total-body workout.

Unlike most in-home exercisers, NordicTrack works all the major muscle groups including the arms, legs, buttocks, shoulders and yes, even the stomach.

It's time to change the spare tire.

So what are you waiting for? Call NordicTrack today.



30-day in-home trial

Models priced from \$299⁹⁵

NordicTrack
A CML Company

©1992 NordicTrack, Inc. All rights reserved.

**For a FREE Video and Brochure,
call 1-800-328-5888 Ext. 113D3**

or write: NordicTrack, Dept. 113D3

104 Peavey Road, Chaska, MN 55318

NordicTrack
A CML Company

☐ Please send me a free brochure

☐ Also a free VHS videotape

Name

Street

City State Zip

Phone ()



Race to the Sun's Edge

GEOFF CHESTER

by Gerrit L. Verschuur

Pioneer 10, the most distant man-made object in history, is already five billion miles from Earth and continues to hurtle away from us at 40,000 mph. Second in the distance sweepstakes is Voyager 1, at 4.7 billion miles, with Voyager 2 and Pioneer 11 lagging behind in third and fourth place, respectively. Their days of planetary encounters behind them forever, these four probes are now looking for the last frontier within reach of instruments from Earth. They are heading for the edge of our solar system. Past the border of the heliosphere—the sun's sphere of influence—they should pass into the vast realm of interstellar space, which extends for thousands of light-years to the limits of our Milky Way galaxy.

For humankind, these probes are truly headed for the final frontier. Once the Voyagers and the Pioneers enter the great interstellar gulf they will drift for hundreds of centuries. In 33,000 years, Pioneer 10 will be within 3.3 light-years of a star named Ross 248. Voyager 2 will have a closer encounter with Sirius—eight-tenths of a light-year—but not for 358,000 years.

The probes leave behind a rich legacy of discovery. The Pioneers, launched in 1972 and 1973, proved that spacecraft could travel through the asteroid belt without being annihilated. Their trajectories then took both past Jupiter and Pioneer 2 past Saturn. They revealed that both planets emitted more heat than they received from the sun, indicating that they are both slowly

shrinking, 4.5 billion years after their births. Today both spacecraft continue to send back information on the fields and particles at the outer reaches of the heliosphere.

The Voyagers, more advanced craft, together photographed Jupiter, Saturn, Uranus, and Neptune in glorious detail. Their portraits of the planets' many moons showed us that no two were alike, from Jupiter's Io with its volcanoes to Uranus' Miranda, a chaotic structure that seems to have shattered and reformed. Launched in 1977, the Voyagers still send data eight hours a day with transmitters that run on a mere 10 watts of power. The data come from instruments that tell of solar wind particle densities and speeds, cosmic rays, plasma waves, radio emissions, interplanetary magnetic fields, and the glow of sunlight scattered by interstellar hydrogen atoms that have leaked into the heliosphere across the heliopause—a barrier, still theoretical, that should mark the beginning of interstellar space. (For more about solar system exploration, see "Beyond Earth," a graphic supplement included with this issue.)

The quest for the heliopause is some-



In a journey that may never be repeated, four aging space probes seek the boundaries of our solar system.

Blown violently out through the sun's super-hot corona, the solar wind streams out into space (right), its presence indicated by the streaming tail of a comet (above). Distant spacecraft now seek the boundary where the wind ends and interstellar space begins.



thing of a bonus. "The goal was not even mentioned in any of the mission objectives," says James Van Allen, principal investigator for the cosmic ray experiment on board Pioneer. The search has been named the Extended Mission for the Pioneers and the Voyager Interstellar Mission for the other two craft, and the acronym VIM, with its connotations of energy and enthusiasm, is an apt one. "There's a feeling on this project which I've never felt on any other," says Mike Kaiser, a co-investigator for Voyager's radio astronomy experiment. "We've been together for so long that we trust one another's experience." Increasingly, in many new projects paperwork drowns creative work, but the VIM project is a throwback to happier times. "We require a minimum of paperwork," Kaiser says as he gets back to his research.

Don Gurnett, professor of physics and astronomy at the University of Iowa and the principal investigator for Voyager's plasma wave experiment, recognizes that the VIM offers "an absolutely historic opportunity. I can't picture when this will ever happen again." Spacecraft will continue to visit the planets, but the business of hurtling them outward as hard as possible will give way to subtler approaches, such as placing them in orbits around the planets. "It is highly unlikely that we will ever again waste a spacecraft by discarding it into deep space," Gurnett says.

Lyle Broadfoot, an astronomer at the University of Arizona's lunar and planetary laboratory and principal investigator for the ultraviolet spectrograph on board Voyager, has been working on the mission since 1970. He regards the twin spacecraft as "old friends," a sentiment shared by other scientists who have spent most of their careers nurturing the Pioneers or Voyagers on their way. "Our UV instruments have been observing all the time," Broadfoot says proudly. "They haven't been turned off



RICHARD NOWITZ

since launch." Like so many of his colleagues, he is keenly aware of the bonus that the VIM represents. "If you wanted to do this experiment for its own sake, you wouldn't get aboard a spacecraft," he says.

To appreciate what this experiment might uncover, it is necessary to consider our nearest star. "We live inside the sun," says Bill Kurth, a researcher at the University of Iowa who uses very-low-frequency radio receivers on board

The Voyager program's extended life has been a scientific bonus for experimenters. Mike Kaiser (above) seeks clues about the sun's heliosphere with the probes' radio astronomy experiment, while Lyle Broadfoot (below) uses their ultraviolet detectors. Detection of the termination shock will indicate that the heliopause is near (right). Beyond that there may be a bow shock, created by the solar system's movement through space.



TOM IVES

Voyager to study solar system radio emissions. The sun's extended atmosphere is defined by the perpetual solar wind, a stream of ions and loose electrons that streams from the corona, a bright halo at the edge of the sun's disk. Scientists had long theorized the existence of the so-

lar wind but couldn't prove it until probes could make measurements in space. Today there are still mysteries about the wind's origins. We know that it is driven by the continual heating of the solar corona, but the mechanism behind the heating is unknown. We also know that the wind's magnetized gases radiate outward at 279 miles per second, about twice the speed of sound in interplanetary space. (On Earth, sound

travels as pressure differences in the air. In space, pressure differences can travel as well, even though there are not enough particles to enable humans to hear anything. The speed of sound in interstellar space is typically 2,000-20,000 miles per second, depending on the temperature and density of the gas through which the pressure disturbance travels.)

The solar wind takes the form of a vast spiral, thrown out by the rotating sun much the way a revolving sprinkler creates spirals of water. The wind radiates past Earth, past Jupiter and Saturn, and even past Neptune and Pluto, creating the "bubble" of fields and particles known as the heliosphere. At some point as it approaches the heliopause, the wind slows to below the speed of sound and the fields and particles pile up in a termination shock, similar to the shock wave created by a supersonic airplane. Somewhere beyond the termination shock, scientists

theorize, lies the heliopause, a wall of plasma and magnetic fields that halts all but neutrally charged particles. At this point the wind's outward pressure is balanced by the pressure of the interstellar medium. And here the solar system ends.

Once they travel past the heliopause, the aging spacecraft should be able to make the first direct measurements of interstellar space. Scientists already have some ideas of what they might find. Observations of starlight suggest that the heliosphere is located in a cloud-like structure known as the Local Fluff. Consisting of diffuse hydrogen gas at a temperature of about 16,000 degrees Fahrenheit, the Local Fluff is 12 to 15 light-years across and includes nearby stars such as Alpha Centauri. Only one particle per ten cubic centimeters of space—about the size of your thumbtip—flit about in the Fluff. (This contrasts with about 100 billion billion particles

in an identical volume of the air we breathe, and the five particles in each single cubic centimeter of the solar wind near Earth.) So although it is hot in terms of molecular motion, the gas is far too diffuse to melt a spacecraft.

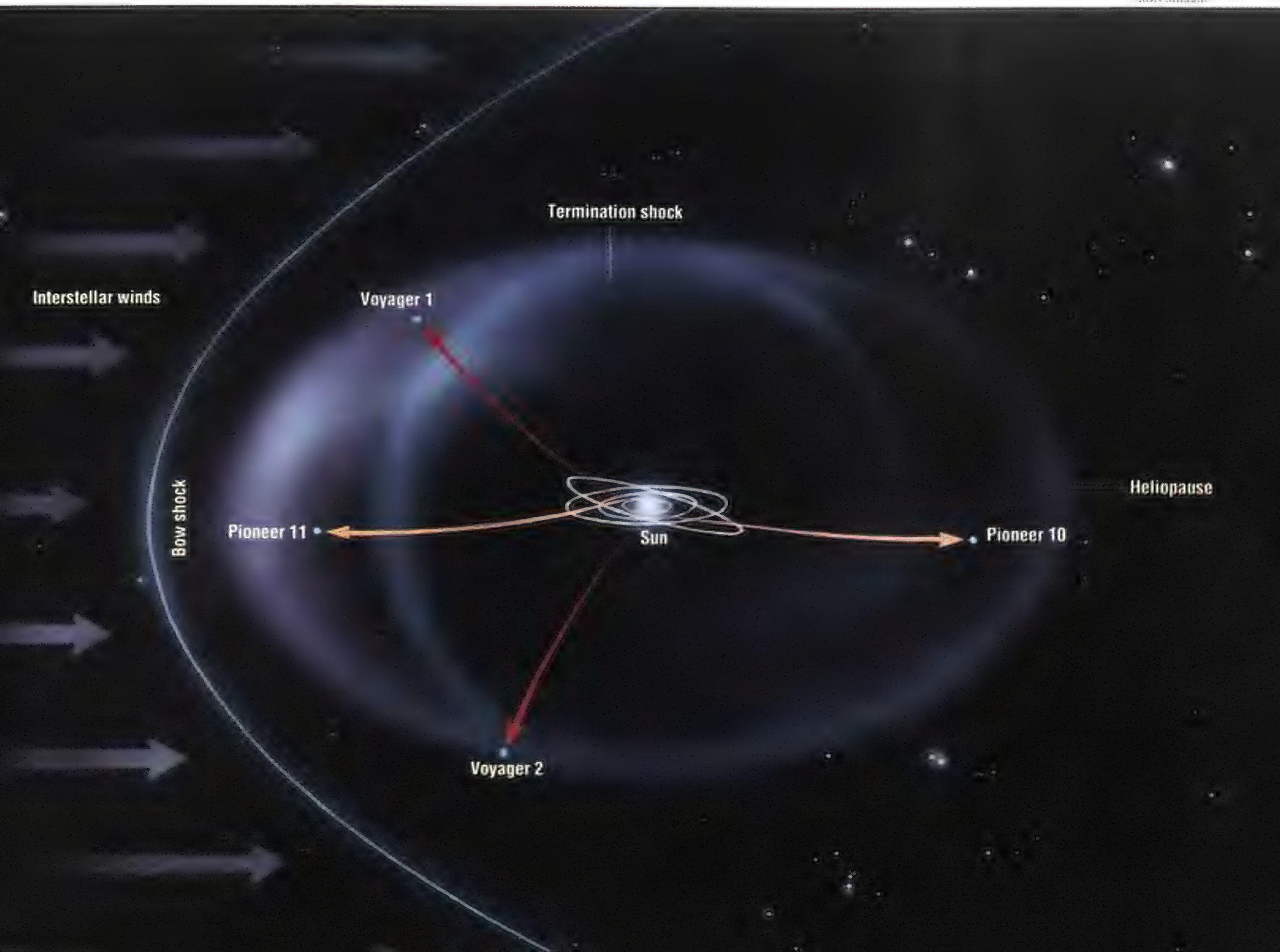
The Local Fluff in turn is contained within the Local Bubble, a vast region hundreds of light-years across filled with gas at a temperature of 1.8 million degrees Fahrenheit and a density of one particle in every 200 cubic centimeters. The gas is so hot it emits X-rays detectable by Earth-orbiting spacecraft. The bubble may be the ancient remnants of a supernova explosion that occurred close to the sun about 100,000 to several million years ago.

Astronomers want to know why the Local Fluff remains intact inside the much hotter Local Bubble. It's a question that may be answered once a spacecraft crosses the heliopause and directly measures the Local Fluff's temperature,

density, and magnetic field. "Finding the boundary will tell us what kind of medium we are immersed in," says Tom Holzer, director of the High Altitude Observatory in Boulder, Colorado. "For example, is it magnetically dominated? The role of magnetic fields will determine where the termination shock is located." Magnetic fields would help provide pressure to counteract the outward flow of the solar wind. The greater the field strength, the lower the temperature of the interstellar gas required to provide pressure balance. "The Fluff should have different characteristics [be hotter, for example], unless there is a large field out there," says Don Cox, a physics professor at the University of Wisconsin in Madison. "Large" is a relative term, however; a strength of .000005 to .00001 gauss would be large for the Fluff, yet minuscule compared with the Earth's field of 0.5 gauss.

How will we know when a spacecraft

RON MILLER





For Pioneer 10—the most distant man-made object until Voyager 1 surpasses it around 1999—the sun is now a distant and ever-fainter star.

reaches the boundary? Magnetic field strengths, from fields that pile up near the boundary, should rise, according to Norman Ness, director of the University of Delaware's Bartol Research Institute. Ness is the principal investigator on the Voyager magnetometer experiment, which can measure magnetic fields as low as .000001 gauss.

Counts of cosmic rays, charged particles that travel at near-light speeds throughout the galaxy, will also indicate when the boundary is near. For years scientists have observed that cos-

mic ray counts on Earth varied in relation to solar activity: when the sun was most active cosmic rays were scarce, and when solar activity dropped to its lowest point in its 11-year cycle, cosmic ray counts rose. During the VIM, Ness and his colleagues have found what they call Merged Interaction Regions, vast concentric waves of particles and magnetic fields that are blown out by the sun and waft through the outer solar system. Beyond the orbit of Jupiter and Saturn the fields and particles pile up to produce the MIRs, which act as



RON MILLER

stellar hydrogen and helium atoms are not stopped by the boundary of the heliosphere, which is only able to impede the flow of electrically charged particles. Like car headlights illuminating raindrops on a stormy night, sunlight bounces off these particles as they flow through the solar system, and instruments on board Pioneer and Voyager detect this backscattered radiation, enabling estimates of the density and flow direction of the atoms. "We expect to see a change in the backscatter intensity due to the boundary crossing," says Lyle Broadfoot. "Out there the flow direction will change, the density will be different. In our case it could be a very subtle change and the transition may last a couple of years."

Mysterious radio waves resonating within the heliosphere may offer other clues to the boundary's location. For a period of about six months in 1983, both Voyagers detected a strong burst of low-frequency radio emissions, and in later years they picked up weaker bursts. To study the signals, the computers on board Voyager had to be reprogrammed by technicians on Earth, millions of miles away. "We have taught the on-board computer to do things it wasn't meant to do," says Kaiser. Two hundred channels of data were consolidated into 16 to focus on the interesting frequency bands, with data sent back at five bits per second—"roughly equivalent to talking speed," Kaiser notes dryly. The electronic signals are routed directly from the Jet Propulsion Laboratory in California to his desktop workstation in Maryland, where he examines them daily and then stores them for later analysis. "To do this work with an instrument built 20 years ago is incredible," he says.

The observations sparked theoretical work in Poland by Andrzej Czechowski and Stanislaw Griedzielski of the Polish Academy of Sciences' Space Research Center. In 1990 they suggested that the emissions may be trapped inside a cavity formed by the heliopause, which acts like a vast echo chamber. Radiation from within the solar system would bounce off the high-density walls of the heliospheric cavity. When reflected a second time from the expanding solar wind in the inner heliosphere, the radio waves' frequencies would increase.

gatekeepers that modulate the passage of cosmic rays into the solar system. The greater the turbulence of the MIRs, the more effective a shield they provide against the rays' charged particles.

One of the key figures in the search for the sun's edge is James Van Allen, who, using the Explorer satellites back in 1958, discovered the radiation belts around Earth that bear his name. Now 78 years old, he has put off retirement to work full time with his beloved Pioneers. His team has discovered that the cosmic ray intensities recorded by Pi-

oneer 10 are now 35 percent greater than what they were at Earth at the same points in the solar cycle, an increase pegged to a lessened modulation of the cosmic rays by the solar wind as the spacecraft travel outward. Once a spacecraft passes beyond the heliopause, cosmic rays will not be affected by the wind, and the counts should remain at an increased level.

Observations of sunlight scattered by interstellar gas particles indicate that the heliopause is not too far away, at least astronomically speaking. Inter-

The increases already observed would be produced by a cavity extending 60 to 100 AU (an AU—for Astronomical Unit—equals 93 million miles, the distance from Earth to the sun).

Though Don Gurnett hesitates to predict when the first probe will reach the boundary, he does expect his plasma wave experiment to provide a warning. Plasma waves are like radio waves but occur at a lower frequency and are more of a local phenomenon. "Strong plasma waves are expected to be associated with the terminal shock," says Gurnett. "Shocks occur in the solar wind ahead of all planetary magnetospheres, and these shocks are always characterized by strong plasma wave turbulence. We have picked up electrostatic noise ahead of the shocks surrounding every planet we visited. We expect this out there as well."

As the four probes continue their search, scientists back on Earth are having difficulty agreeing when they will find the heliopause. The scientists exchange friendly jibes about which spacecraft will reach the boundary first, but no one is holding his breath. Says Van Allen, "The race to the heliopause is a friendly competition," kept within the walls of the physics and astronomy department. Yet the competitive urge may be stronger for NASA's Ames Research Center at Moffett Field, California, which manages Pioneer, and JPL, responsible for the Voyager program. Ames maintains that Pioneer 10 became the first probe to leave the solar system when it passed beyond the orbit of the outermost planet in 1983. JPL disagrees, preferring to place the boundary at the heliopause, which its Voyager 2 will probably reach first. "I think if you talk to the bulk of the scientific community and the lay people who read about astronomy that's what they would define it as, as the solar system of planets," says Palmer Dyal, deputy director for space research at Ames. "People who work in cosmic rays and plasma physics have another concept of the solar system: as the distance where the sun's influence stops and the



JON VAN ALLEN, UNIVERSITY OF IOWA FOUNDATION

James Van Allen's work with Pioneer caps a career that includes historic work with another pioneer: Explorer, the first U.S. satellite.

influence of other stars takes over, at the heliopause." But, Dyal acknowledges, "Both are applicable."

Theoretical estimates of pressure balance between the solar wind and the Local Fluff suggest the boundary will be found at around 100 AU. But it could be as close as 50 AU or as far as 200 AU. "My best prediction is 100 AU, give or take a few," says Van Allen. Norman Ness hopes that the crossing will come by the end of the century, at about 80 AU, "based on our knowledge of the changing characteristics of the medium." Bill Kurth jokes that estimates of the boundary's location move outward at the same speed the spacecraft advance toward it.

Whose predictions will turn out to be correct? "I don't think that any of the current models will turn out to be very accurate," says Don Cox. But he admits that so many people are now working on this question that "one of them may have got it right."

"The crossing may only be recognizable after we're through," Kaiser says. "It won't be a benchmark affair such as a planetary encounter." It may even take weeks or months, and only after it is all over will someone recognize that it has happened.

Everyone agrees that the crossing

will be a benign occasion. As Van Allen puts it, "We all survived the Jupiter and Saturn flybys with their vast increases in particle counts. Out there nothing should happen that will affect the instruments. Only random failure will prevent them from detecting the heliopause."

The survival prospects for Pioneer 10 and 11—at 56 and 37 AU, respectively—are not great. Van Allen estimates that Pioneer 11 will cease to operate effectively in a couple of years because its radioisotope thermoelectric generator, which provides the probe's power, is deteriorating. Pioneer 10 should

last until around 1999, by which time it will be beyond 70 AU but probably still short of the boundary. By shutting down some heaters and running in a lower-voltage configuration, "we may be able to eke out another year," says Palmer Dyal. "We think we have a chance with Pioneer 10 to find at least the inner limits of the heliopause."

The Voyagers, both beyond 40 AU, offer better odds. Voyager 1 will overtake Pioneer 10 around 1999 and become the most distant man-made object in space. "It has the best prospect of encountering the boundary," predicts Van Allen. The VIM expects to receive data for another 25 years before the transmitters on board those spacecraft die. By then the Voyagers will have traveled as far as 130 to 140 AU.

The scientific saga of the race to the solar system's edge is an extraordinary tale of scientists making creative use of limited resources to learn as much as possible about a subject that would never have received a mission of its own. The subject of study is remote, yet it provides a fascinating subject for human curiosity and a challenge that may be met in our lifetime. It's also an experiment that may never be repeated. Our species finds it difficult if not impossible to comprehend experiments that last for centuries, and unless we launch missions to study other stars, the Voyagers and Pioneers will be pathfinders without followers: the first and last emissaries from this planet to journey out of our solar system. ➔

THE SMITHSONIAN TRAVELER



■ TO REQUEST TOUR AND SEMINAR BROCHURES, CALL (202) 357-4700.
■ TO REQUEST RESEARCH EXPEDITION BROCHURES, CALL (202) 287-3210.
■ OR WRITE TO
SMITHSONIAN NATIONAL ASSOCIATE PROGRAM, WASHINGTON, DC 20560.



FOREIGN STUDY TOURS

Available Now! Our new, FREE, full-color catalog of international study tours and seminars. Call or write to receive your copy.

Countryside Tours May-October: Sojourns in France, England, Italy, Austria, Switzerland, Czech Republic, Ireland and Mexico.

China Tours June-October: Seven itineraries.

Odyssey of Flight June 3-14: Paris Air Show.

NEW Canterbury Tales June 3-15.

NEW Bohemia and Moravia June 6-20.

Inside Ireland June 7-18.

Poland June 9-22.

NEW Victorian Holiday: England by Train June 17-28.

British Isles Cruise June 23-July 7.

NEW Maritime England July 1-13.

NEW Musical White Nights (Russia and Finland) July 3-15.

Iceland Adventure July 11-24.

Swiss Walks July 16-29.

Historic Nova Scotia July 18-29.

Tibetan Journey July 21-August 7.

Canadian Rockies July 24-August 2: Hiking.

Kenya Wildlife August 3-20.

Amsterdam to Lisbon Cruise August 4-18.

NEW Rhine-Mosel Cruise August 5-19.

NEW Swiss Alpine Hike August 7-21.

Trans-Siberian Railroad August 8-22.

NEW French Canadian Waterways August 14-28: Cruise on the St. Lawrence River.

Edinburgh Festival August 16-26.

Switzerland by Train August 18-30.

Russia's Golden Ring August 20-31.

Baltic Nations August 24-September 6.

French Waterways: Paris to Burgundy August 27-September 7.

NEW Mongolia and China August 29-September 19.

Indonesia September 1-23.

NEW Chianti Walks (Italy) September 2-14.



DOMESTIC STUDY TOURS

Smithsonian "Anytime" Weekend (Washington, D.C.) From \$99 per person, two-night package includes hotel and behind-the-scenes tour. Enjoy lectures and concerts at Smithsonian museums.

NEW Delta Queen May 8-21: Pittsburgh to New Orleans.

Hudson River Historic Homes May 15-20.

Arches and Canyonlands May 16-23.

Historic Boston May 19-23.

Smithsonian Treasures (Washington, D.C.) May 19-23: For Contributing Members.

Native Cultures of the Southwest May 23-June 2 or August 22-September 1.

Grand Canyon Rafting May 28-June 6 or August 20-29.

NEW Accessible Adventures June-February: introducing outdoor programs designed for people with and without disabilities.

Smoky Mountains Hiking June 5-13.

Alaska's Inside Passage June 6-20.

Alaskan Landscapes June 11-22 or July 9-20.

Chicago Architecture June 16-20.

NEW Route 66: Scenic Southwest June 18-26.

California's National Parks June 19-26.

Frank Lloyd Wright (Wisconsin) June 20-26.

NEW Yellowstone Hiking June 20-30.

NEW Massachusetts Heritage June 26-July 4.

Oregon July 4-11: Natural History.

NEW Beyond the Bering Sea July 11-21.



ODYSSEY TOURS

Low-cost tours (1993): Great Britain, Italy, France, Greece, Portugal, Spain-Morocco, Alps, Israel-Egypt, Belize-Guatemala, Canada and the United States. Six tours to Costa Rica will also be offered in 1993. For an Odyssey brochure only, call 1-800-932-8287.



SEMINARS

Discovering the Blues (Chicago) June 21-24.

Paris June 24-July 4.

Georgian England July 10-20.

Billy the Kid (New Mexico) July 27-31.

Hawaiian Botany/Volcanology (Hilo, Hawaii) August 8-12.

Adirondack Ecology (Blue Mountain Lake, New York) August 8-13.

Mackinac Island Heritage (Michigan) August 23-26.



RESEARCH EXPEDITIONS

Contribute your talent and financial support to Smithsonian research. For information on Research Expeditions only, call: (202) 287-3210 or write Smithsonian Research Expeditions, MRC 933, Washington, D.C. 20560.

Bali, Indonesia June 2-15: Work with anthropologists to document a dance and musical festival.

Washington, D.C. June 6-19: Create a planetarium show for schoolchildren.

Worland, Wyoming June 19-July 3 or July 4-17: Excavate remains of dinosaurs.

Washington, D.C. July 18-31: Archive treasures for the National Air and Space Museum.



NOW PLAYING AT AN AIRPORT NEAR YOU

From April to October, airshow veterans
never get a weekend off.

by Phil Scott

Photographs by Lee Battaglia

The little airplane dives toward the crowd, trailing smoke. Just before a crash seems imminent, it pulls up and roars off, skimming the runway. An announcer's voice echoes through the Aerospace America airshow crowd. "These are the maneuvers...that allowed Daniel Elegwa-elegwa...to be named...by a very competent panel of judges...the champion aerobatic pilot-ilot...in the entire country of France-ance-ance!" There is a smattering of applause from hundreds of sun-baked Oklahomans.

To fly as close as the French Connection does in their formation aerobatic routine (left), you have to be in tune with your airplane and your partner. Montaine Mallet and Daniel Heligoin preface each performance with a preflight and a kiss (above).



Inside the performers' tent, the June heat is stifling. As Daniel Heligoin, one half of the French Connection airshow team, loops and rolls his tiny Mudry

Cap 10B monoplane above, Montaine Mallet, the other half of the team, watches from the tent. Someone asks her if she ever worries about her husband.

"Worry? Of course you get worried," she says, and then seems to remember some unwritten airshow pilot's code. "You don't worry that an accident would happen," she explains. "You don't feel—you worry if your love goes on the road. You worry."

Heligoin, 60, and Mallet, 44, have been on the road for 16 years now as the French Connection, flying about 20 weekends per airshow season, which runs from April to October. The roar of the crowd and the smell of the grease fittings is a siren song, but a performer's lot is not always a happy one. "Sometimes I'm amazed at the response we

Performers must put their best feet forward on the ground as well as in the air. Between interviews, media rides, schmoozing with sponsors, and signing autographs, Heligoin and Mallet find a few minutes to grab a bite (above right).

get," Mallet says, highly expressive despite occasional lapses in English, "but it didn't happen overnight. When you come back on the ground and you don't see any crowd, you ask yourself *Are they all in the bathroom or eating hot dog?* There were times when we landed after a performance and there were lots of other performers getting a better response. It's upsetting, but you have to learn from that."

The French Connection is part of a tightly knit community of a few hundred pilots who have run off to join the flying circus. It is not a happy-go-lucky lifestyle; the airshow industry has be-



come increasingly complex and competitive. Last year airshows entertained 24 million people, twice the number of fans who attended NFL football games. Performances run from sublime to ridiculous. At a big show, between the souped-up Stearmans and the military demo teams, you may see a jet-powered dragster race a high-performance biplane or a huge fire-belching mechanical "Robosaurus" munch an evil drug-runner's airplane. At night a group may reenact the Battle of Britain; during the day they'll give you the whole war.

The smaller shows, a staple for acts like the French Connection, can't afford to book too many performers. Some shows, like those in Saint Cloud, Minnesota, and Lake Charles, Louisiana, have shut down for the duration of the recession. Nonetheless, the International Council of Air Shows, a trade association with 770 members, keeps growing. About a third of its members are promoters and another third are performers who vie for billing. (The balance consists of vendors and suppliers of everything from hot dogs to inflatable airplanes-on-sticks.)

For a performer, just getting started can mean an investment of hundreds of thousands of dollars. Sean Tucker, a 40-year-old Salinas, California crop duster and an up-and-coming face on the airshow circuit, says he spent \$150,000 to set up his airplane and his act. Now sponsored by Randolph Sunglasses, he makes about \$5,000 per show, plus mileage and lodging.

Many performers finance their weekend acts with the earnings from their nine-to-five jobs; other acts, like Tucker, depend on big-name corporate sponsorship. The French Connection is among a handful of acts that bring in most of their income by performing.



They too have a couple of sponsors (Northstar Avionics and Mobil), and they run the Mudry aircraft dealership in the United States and teach aerobatics on the side, but their bread and butter is the airshow circuit.

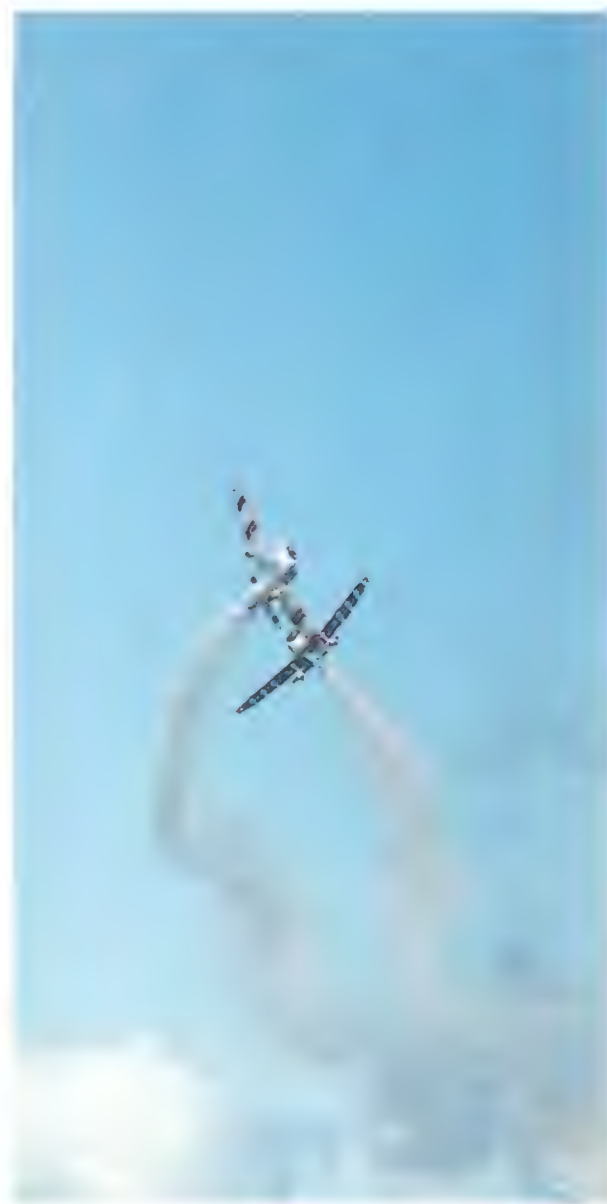
Recently married and relocated from Poughkeepsie, New York, Heligoin and Mallet have bought a tidy, modest house in a development near Flagler County Airport in Bunnell, Florida. The sunny and gregarious Mallet manages the business; Heligoin smokes, grins, and flies. He prefers to let his wife do the talking.

Their route to show business was laid out in the early 1970s, when Mallet, recently graduated from college with a degree in aeronautical engineering, was looking for a job. Because she was born with poor vision in one eye, she didn't think she'd have much luck landing a job flying professionally. "Somebody told me about this new design just coming out, the Mudry Cap 10," she says. "It had a military contract with the French air force; they were using it as a screening aircraft" (the piston-engine Cap 10B is a primary train-

er for the French air force and navy). The Avions Mudry company needed an engineer; Mallet got the job. Company president Auguste Mudry was eyeing the American light-aircraft market, back when there was such a thing, and in 1973 he sent his chief pilot—Heligoin, an ex-French air force captain who had trained with the U.S. Air Force in the 1950s—to test the waters in upstate



Heligoin, twice France's aerobatic champion and a former member of the French air force jet team, taught Mallet to fly formation and choreographed a routine that capitalizes on their trust in each other.



New York. Mudry also sent his newest engineer. "He figured I know how to keep a budget," says Mallet. "Daniel would probably spend the money in two days."

Within three months they realized Mudry would need to spend ten times what he had figured to promote the trainer in the United States. "So we went to Plan B," says Mallet, "which was to start an aerobatic school where we can show people that the aircraft is really good and we can make a couple of bucks doing that." She taught aerobatics, and Heligoin, twice France's aerobatic champion, performed at airshows. (Good thing they went to Plan B: sales of the \$165,000 Cap 10B were never brisk. In the last three years, they've sold one—used.)

After he taught Mallet to fly formation, Heligoin choreographed a show, in which Mallet leads and Heligoin follows. It's a series of formation loops, barrel rolls, hammerhead stalls, head-on passes, and a trademark maneuver in which Heligoin rolls inverted over Mallet and flies a mirror-formation circle with inches separating the two canopies. All this is performed to a tape of Beethoven's "Ode to Joy," Strauss' "Blue Danube," and Mallet's taped read-



ing of a poem called "Formation Flight" ("*...We form wing to wing, becoming one mind.... A feeling of so much closeness, a bond as strong as the universe...*"). The act lasts 17 minutes, which, according to conventional airshow wisdom, is the audience's attention span for a two-plane act.

When Heligoin and Mallet first took their show on the road there were no hand-held video cameras; they could only guess what the audience saw. In the evening they'd huddle in front of a TV, scanning channels to get a glimpse of their performance on local news shows. After seeing minute fragments of footage, they'd fly the show again



Bob Hoover, an airshow pilot's pilot, has been flying shows for 25 years. His straw Panama is as distinctive a trademark as his performance in the Aero Commander Shrike, a business airplane that does not usually hang with the high-performance aerobatics crowd.

with their hands, correcting, tightening, and smoothing the performance. Compared to the standard high-powered, flag-waving airshow fare, with the national anthem echoing and fighters screaming by in afterburner, the French Connection's performance is a study in serenity. "There's enough people who want to go zip-zapping and get everybody tense," says Mallet. "For aviation, we are the freestyle program."

No one runs off to join the flying circus for the glamour of it. "This is a young person's life," says Mallet. "I don't want to be doing this for another ten years." And, as in real estate, to make a small fortune you have to start with a bigger one. "Once you pass the first ten years you can make a living in airshows," Mallet says. "If we had kids we could not have raised them. But we are only the two of us, we live in the same house, and only have one car." (They've made their married status a selling point: when a show books the French Connection at \$6,500 for two days, it gets two airplanes but it only has to provide one motel room and one car.)

But show sponsors don't always care enough to send the very best, Mallet says. Sometimes the room is a cubbyhole, sometimes the car won't start. "But we try to stay low-key," she says. "We used to tell them if it was a bad show, but then we did not get invited the next year."

They prefer to perform somewhere in the middle of the lineup, but not following a heavy like the McDonnell Douglas AV-8B Harrier. "They have to let it cool off in front of the crowd for 10 minutes, and by then your act is almost over." (The little acts' chief competitors, the military demo teams like the Thunderbirds and Blue Angels, usually do their one-hour shows last.) "We like to see airshows organized like Las Vegas shows," says Mallet. "You have the dancing, you have comedy act, you have chimpanzee, the music, and everyone goes on on time."

Things go fairly smoothly at June's Aerospace America airshow in Oklahoma City. Many performers say they like working Aerospace America because it's well organized and books the top acts—the Golden Knights, the Red Baron Squadron, Bob Hoover, the Pepsi Skywriter, Sean Tucker, Manfred Ra-





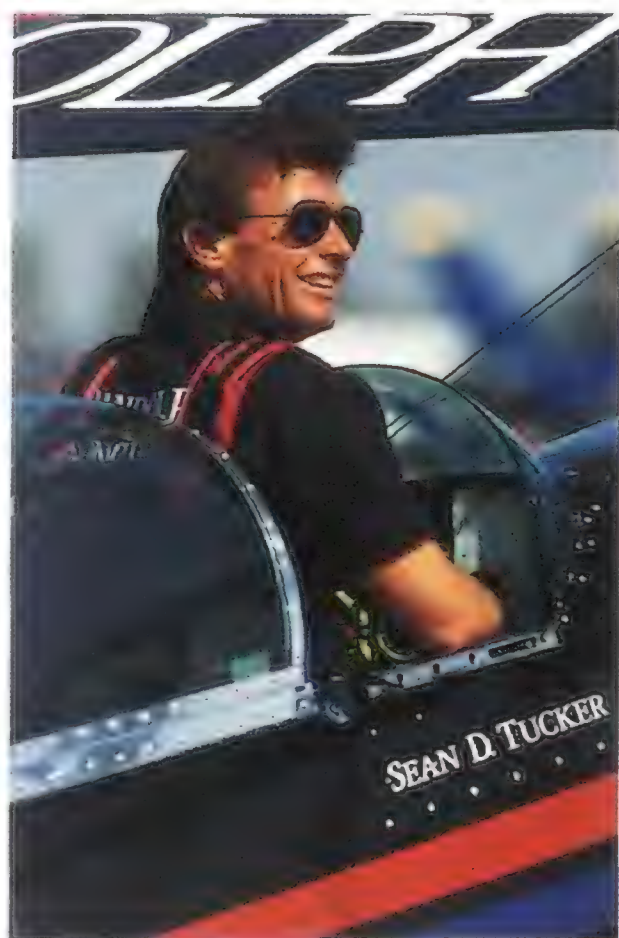
dus, and the French Connection.

Aerospace America is the French Connection's second show on a two-week circuit that will take them to Tennessee, Oklahoma, Ontario, and back to Florida. Their schedule is lighter than usual, due to the team's move, but August would be full: Oshkosh, Pittsburgh, New Brunswick, and Sussex, New Jersey. Before setting off, Mallet packs her airplane with paperwork—bookkeeping, billing, and inventory—which she does on a laptop computer. Heligoin packs tools, spark plugs, screws, Dzus fasteners, a tire tube, and an extra starter. They cram in clothes and luggage and take off for Gallatin, Tennessee. Arriving early in the week, they take the local media for rides, schmooze with local show sponsors, fly two shows, do the books, and then set out for Oklahoma City.

The Aerospace America crowd arrives early in the day. During Heligoin's solo act ("To fill time," Mallet says), a tall, lanky man in a green flightsuit and

a wide-brimmed Panama hat strolls by the performers' tent. Heads turn on both sides of the orange snow fence that keeps the crowd back. "That's that Bob Hoover guy," says a woman in the audience as she bolts for an autograph. Having flown aircraft demos since World War II, the 71-year-old Hoover is a legend, and performers often quote him. "Like Bob Hoover says, 'When you stop loving it, just stop,'" says Mallet. Young Sean Tucker says, "I have a commitment to not bustin' my butt, as Bob Hoover would say." Even Hoover quotes Hoover: "Like I always say, if you ever get tired of it, just quit."

Hoover flies an aerobatic routine in a buttoned-down twin-engine Aero Commander Shrike, and his act has not changed much since the airplane's manufacturer sent him on the airshow circuit in 1968 to boost sales. For a big finish, he shuts down both engines at 3,500 feet or so and loops and rolls down to a landing, in which he alternately touches one main wheel to the runway and



Delmar Benjamin invested three years and \$200,000 in his replica of the 1930s Gee Bee racer, which hit the airshow circuit last year and always draws crowds of chatty admirers (below).





RICK CARVER

A new face on the airshow circuit, Sean Tucker (above, left) has perfected a triple ribbon cut (above) that has made him a hit and earned him a sponsor.

then the other before coasting to a stop directly in front of the crowd.

Hoover's seniority and skill make him a top draw with audiences, but today's younger performers are constantly looking for new gimmicks to capture that short attention span. Night flying is on the rise, perhaps an indication of how stiff the competition has become. Steve Oliver, one of the first to revive flying with fireworks, had flown the previous night in his de Havilland Chipmunk, the Pepsi Firedancer, which by day becomes the plain old Pepsi Skydancer. "We brought back nighttime pyrobatics," he laments, "and now everybody's jumping on the bandwagon." Oliver's wife, Suzanne Asbury-Oliver, flies the Pepsi Skywriter, a big 1929 Travel Air biplane.

Gene Littlefield and his wife Cheryl Rae fly the after-dark show, but they light their Stearman electrically. Theirs is the only night wingwalking act on the circuit—for now. "Cheryl's athletic," says Littlefield. "She's so well equipped for it, and she's so predictable. I surprised her once, though. We had an engine failure in the worst possible position: low, upside down, and she was on the wing. We were able to roll it over and touch right down." (The next year, his peers asked if he planned a similar show-stopper.)

Heligoin, who is spending a great deal of this show tinkering with the smoke system on Mallet's airplane, has second thoughts about flying night shows, and in a rare moment of loquaciousness confides, "The pyrotechnics itself is going to cost you ten thousand bucks before you ever get started, and on top of that, pyrotechnic in formations—we are thinking it might be a little unhealthy. But we've been asked. Maybe a solo."

He and Mallet fire up their engines while a Hawker Sea Fury pours white smoke high above the crowd ("Rolling! Spinning! Diving! The prop begs for mercy!" the announcer emotes). They had preflighted the airplanes thoroughly and Mallet had run through their psychological checklist: "If your aircraft are well maintained and if we brief before we go, if we pay attention to the weather, if we are not tired, not aggravated, not mad, if we're rested, everything is going to go fine."

Delmar Benjamin, a laconic 40-year-old Montana wheat farmer with curly blond hair and a replica of the Gee Bee racer, waits on deck. A brutish 550-horsepower low-wing monoplane, the original Gee Bee Super Sportster, with Jimmy Doolittle at the controls, won the 1932 Thompson Trophy, but it and other Granville Brothers creations wound up killing four pilots. Although Benjamin has been flying shows in a Pitts and a Bucker Jungmann for 10 years, this was his first year with the

Gee Bee. "I wanted to fly exactly what Jimmy [Doolittle] flew," he says. "I have a lot of respect for the aircraft. I'm aware that it could kill me, but I have the satisfaction of mastering what's said to be the most dangerous airplane ever flown."

For Benjamin, who borrowed \$200,000 to build the Gee Bee from old photos and drawings, the real risk lies in the

doubt that people will ever get tired of it," she says. "Too many people want to see it, and we've even had folks follow us around just to keep seeing it." Tana met Delmar as a teenager, when both were dragging Main Street in their hometown. "When I saw Del tip up a carton of milk, I fell in love with him," she says. To keep the family together,



CONKLING PHOTOGRAPHY

The Gee Bee has a face and a fuselage that only a pilot could love. The Granville Brothers' brutish racers killed four pilots; nonetheless, Benjamin duplicated the original, reasoning, "I wanted to see what the Gee Bee flew like."

economics and attention span of the show circuit. With the Gee Bee, what you see is what you get. There's no smoke system or pyrotechnics, and you can't stick your wife out on the wing. That leaves a plain vanilla routine of rolls and passes. But Benjamin's wife Tana, who announces for him and sells Gee Bee T-shirts, doesn't worry. "We

she and their two teenage daughters fly to some shows. Still, "airshow business is business," she says. "We do get to travel a lot, but most of the time we go to the motel and watch the Weather Channel. We watch a lot of the Weather Channel."

The Littlefields taxi back, Cheryl Rae on the wing waving an American flag.



"I wonder how her hearing is," a show pilot says.

Then the French Connection is over show center in a tight formation loop that turns into a formation hammerhead stall. They split off, climb, and do it again. They cross paths, roll, dive, and cross again, cutting a smoky heart into the sky. Over the PA system Mallet's words are indecipherable.

Pulling up to the flightline in formation, they stand, wave, and in unison bow from their cockpits, first left, then right. The audience and other performers applaud. "It was like a ballet," says a lineman. As soon as Heligoin and Mallet climb down from their airplanes they confer, in rapid-fire French, first about Mallet's ailing smoke system and then about how soon she wants to start working the crowd. Heligoin fires up a cigarette and goes in search of a cold drink. Mallet commandeers a golf cart and driver, fetches Heligoin, and lurches toward a hangar filled with booths selling lithographs, pins, and little biplane models made with beer cans. Sweaty kids in Garth Brooks T-shirts stand by the show pilots' autograph table in awe. Mallet signs a program for a shy girl named Darcey and passes it on to Heligoin, who scrawls his name with a Gallic flourish and hands it to Manfred Radius, an Austrian-born aerobatic sailplane pilot. Radius flips through it, looking for his photo. "You should always memorize the page number," admonishes Mallet, always the manager.

Radius, based in Toronto, hauls his

sailplane from show to show in a trailer hitched to a van. "A trucker's life is not an attractive life," says Radius, a 48-year-old bachelor who likes to lean into you when he's making a point. "Being away from home, making a satisfying living out of a suitcase in this business...[it's] extremely hard for someone to sit on the passenger seat of a van. No hotel room can substitute for a home." Radius pauses, then switches gears. "However, I am proud to say I have the reputation of being the best glider act in North America."

"Y'all having a good time in Oklahoma?" a woman asks. "Beautiful," says Heligoin. "You're my new favorites," she says, handing him a beer. The French Connection poses for a photo, then signs programs, hats, and styrofoam gliders.

"So far the trip has gone very easy," Mallet says. "You usually have to do promotion *and* work on the aircraft. Very often you work late into the night. Some days you laugh. Sometimes you get aggravated. After three or four days you haven't had a decent meal, or time to eat, especially us French. We are wanting a nice atmosphere, with another airshow couple. You always try to cheer each other up, but we still love it. You see another performer getting better, you see people enjoy the show."

She pauses for a moment, considering the alternatives. "Of course, you could never take a nine-to-five job. You know that." ➔

Life on the road doesn't leave much room for quality family time, so Tana Benjamin travels with her husband, selling Gee Bee T-shirts and announcing (above left). However, one motel looks pretty much like the next one, and Tana and her kids "watch a lot of the Weather Channel."



A League of Nations

A.D. (Bert) Welliver, Senior Vice President—Engineering and Technology, the Boeing Company

To be the global leader in aerospace in the next century, America must recognize what made us the global leader in aerospace in this century.

When Orville and Wilbur Wright's *Flyer* lifted off from the sands of Kitty Hawk, it was powered not only by the genius of two brothers from Dayton but by the dreams, visions, and technical advances of pioneers from around the world.

Italy's Leonardo da Vinci, Australia's Lawrence Hargrave, and England's Roger Bacon, Frederick Lanchester, and George Cayley were all there in spirit, along with the Montgolfier brothers of France. And, of course, there was Germany's Otto Lilienthal, the glider pilot who had died seven years earlier while trying to solve the puzzle of flight. His writings, however, lived on, inspiring the Wrights to build a powered aircraft.

From the start, aviation has been an international endeavor. Successful participants have always built on the varied strengths of many nations, much as the craft that rose from the North Carolina dunes built on the varied strengths of fabric, wood, and wire. Today, however, some believe that international cooperation is to be feared. They assume that the United States can maintain its lead in aviation only by resisting the tide of global alliances. By going it alone, some say, we can remain the leader.

This view, however, ignores history. To be the global leader in aerospace in the next century, America must recognize what made us the global leader in aerospace in *this* century. We have become strong by expanding our horizons.

In the early days of flight, aircraft were designed simply to rise from the ground and gently circle a farmer's field or open plain. But aviators soon began linking distant cities. The culmination came when Charles Lindbergh landed in Paris one night in May 1927, 33 hours after leaving New York. People knew then that aviation's destiny was to connect the four corners of the world.

For airplane manufacturers, this destiny has driven the internationalization of technology. The greater an aircraft's ability to link far-off places, the more likely it is to be a product of the skills and intellects of

men and women around the planet.

When an airplane was meant to fly only a few hundred miles, it was likely that most of the technologies and components that made such a hop possible came from only a short distance away. One reason for this technical isolation was that the markets served by these airplanes were isolated themselves. Engineers worked to solve specific problems, such as developing the power needed to cross a certain mountain range or carry the mail from one particular place to another. In fact, many early biplanes, tri-motors, and other types were built to serve one route and one route only. If you needed to fly from San Francisco to Denver, you built an airplane that could do that job.

Today, of course, that's not the case. Modern airplanes cross oceans as routinely as people cross the street. Worldwide, passengers fly nearly seven trillion miles each year. Technology has followed the same global course, becoming increasingly international as well.

While U.S. manufacturers have produced the majority of jetliners now in service, the roots of these majestic machines can be found in the work of people from many lands. The swept wings that make high-speed jet flight possible were first studied in the 1930s by Adolf Busemann of Germany and first publicly discussed at a 1935 conference in Rome. After World War II, American engineers perfected this new technology, launching the Jet Age with airplanes such as the Boeing 707 and the Douglas DC-8.

The same is true of the jet engine. The centrifugal-flow turbines developed by the British in the late 1930s and early '40s, together with axial-flow designs from Germany, laid the groundwork for the engines that power all modern airliners. By linking with foreign partners, American manufacturers were able to gain the fundamentals of a new technology, then improve upon the technology to create something better.

Today's commercial airplane is too complicated to be the product of any one company or country. In fact, even individual

When building the airliners of the future, we must remember that the first step toward leadership is partnership.

components and systems are increasingly the result of international collaboration. As air travel grows—forecasts call for it to more than double by the year 2010—these international ties will grow as well.

We are seeing the signs of this movement already. Two of the most innovative examples come from the former Soviet Union. One is Air Russia, a joint effort of British Airways and Aeroflot. This new carrier will soon begin flying Boeing 767s between Europe, Asia, and Russia. Imagine combining American airplanes, British flight crews, and the once-closed cities of the East.

Yet the emerging democracies are not simply waiting for outsiders to bring state-of-the-art aviation to them. The British-Russian Aviation Corporation, or Bravia, is combining Tupolev air frames with Rolls-Royce engines. The result is a medium-size airplane that may one day be sold around the world.

How can the United States respond to these and other international collaborations? My answer is that we remember the success a global outlook has already brought us and continue to look for the best partners worldwide. Working with foreign companies teaches us new skills and introduces us to technologies while also opening new markets abroad. International cooperation is our best strategy for securing a position in the 21st century marketplace.

Ties to Asia, for example, provide opportunities to learn about new forms of advanced manufacturing. More efficient assembly line and quality control techniques are areas where Japanese companies are world leaders. Becoming partners with these firms provides U.S. companies with access to this vital knowledge.

Sharing research is also essential. The Soviet Union, for instance, produced some of the finest scientific minds and best laboratories in the world. The Russian Central Aero-Hydrodynamics Institute is a leader in high-speed research, with a wind tunnel complex capable of testing at speeds ranging from Mach .15 to Mach 1.7. Specially designed for low turbulence, this facility could play a role in developing supersonic

transports and other future vehicles. By forging links to the Commonwealth of Independent States, we will be able to apply some of this aerodynamic research to the airplanes of tomorrow. That will help keep our products competitive.

As a last example, consider environmental protection. Truly, this is a challenge to the entire planet and it is certain that new forms of transportation, such as the next-generation supersonic airliners, will be built only if they are ecologically sound. That is why U.S. manufacturers, including Boeing and McDonnell Douglas, have joined the Supersonic Commercial Transport International Cooperation Study Group, which is studying technologies that will produce both supersonic flight and less pollution. By participating in this work, U.S. firms ensure that we will not be left behind when the next revolution in flight occurs.

Still, there are those who will insist that working with international partners undermines our future position. They argue that technology should be contained, not shared.

Sadly, the Wright brothers' own experiences illustrate the impossibility of containing technology. In 1905, frustrated by the government's lack of interest in their stunning achievement, the brothers locked up their flying machine for nearly two years. Instead of making progress, they engaged in a bitter patent fight to prevent others from duplicating their success. The effort was fruitless. By 1909, aviators in Europe and the United States were taking to the skies in more advanced designs of their own. The Wrights never regained their lead.

The United States has been the world leader in aviation since the industry began. While Americans brought powered flight to the world and made the jetliner an object as ordinary as a city bus, these achievements were possible only because we looked outward, seeking the best ideas from around the globe. We must remember the role that international cooperation has had in our own success. We must keep our horizons wide, our vision global. ➔

International cooperation is our best strategy for securing a position in the 21st century marketplace.

We Fit Hundreds Of Advan



You're looking at a rugged sport utility vehicle that holds some of the biggest innovations in the 4x4 world.

Grand Cherokee Limited, the most advanced Jeep vehicle ever.

Its revolutionary Quadra-Trac[®] all-the-time four-wheel drive system automatically adjusts the power supplied to each axle to help deliver optimum traction and superior control

on all kinds of road surfaces.

Its sophisticated Automatic Temperature Control system, which uses an environmentally conscious refrigerant, electronically monitors the interior to

ncements Into A 4x4 Area.



make sure the driving environment stays at your precise setting.

And if you're looking for power, Grand Cherokee is the only vehicle in its class with an available

V8. It also features four-wheel anti-lock brakes, an exclusive driver's side air bag, and the Quadra-Coil suspension system.

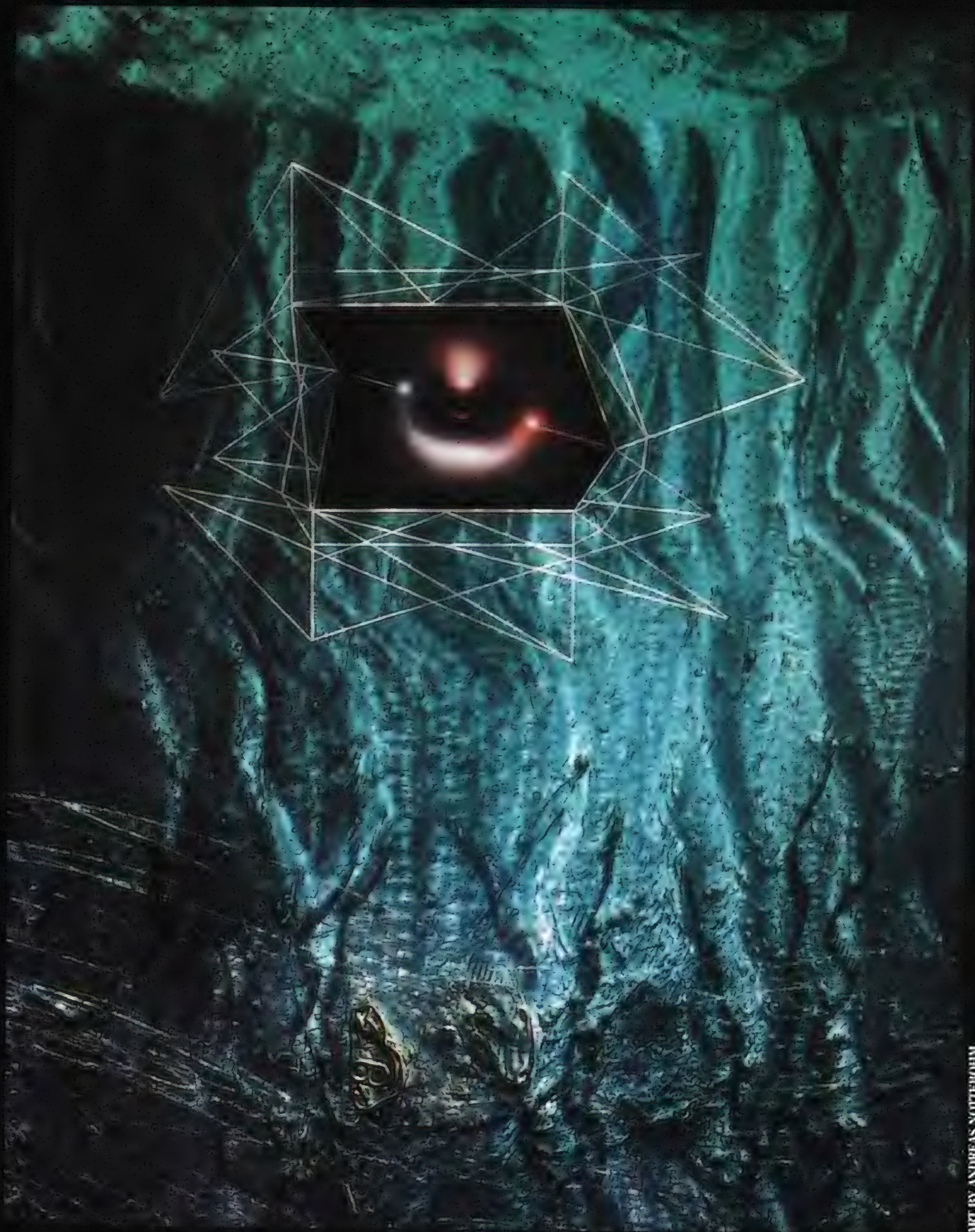
For further information, call 1-800-JEEP-EAGLE. And

prepare to be amazed at how much technology our engineers were able to fit into a 4x4 area.

There's Only One Jeep® 
A Division of the Chrysler Corporation. 

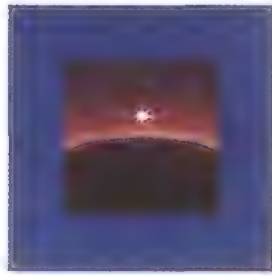
See limited warranties, restrictions, and details at dealer. Jeep is a registered trademark of Chrysler Corporation.

Buckle up for safety.



ART BY ANDREAS NOTTEBOHM

ASTRONOMY'S
MOST WANTED



FOURTH IN A SERIES

IS SOMETHING OUT THERE?

*Following the death of its most ardent advocate,
Planet X remains as elusive as ever.*

by Frank Kuznik

Like the heretic who was felled from his horse by a bolt from Heaven, the late astronomer Robert Harrington could recall the exact moment he was converted. It was June 30, 1978, and Harrington was driving from his office at the U.S. Naval Observatory in Washington, D.C., to his home in the Virginia suburbs. Earlier that afternoon he had examined a photograph that his colleague James Christy was sure revealed an undiscovered moon of Pluto. While sitting in rush hour traffic Harrington entertained himself by mathematically calculating the impact of such a discovery.

"The number came out just about the time I was crossing the George Washington Parkway," Harrington remembered last summer. "and I was so startled I almost drove off the road." His excitement was understandable. The arithmetic he had performed in his head convinced him that there must be a 10th planet. "My God," he thought, "the planet they were looking for in 1930 hasn't been found yet. Pluto isn't it."

And so another astronomer was lured into the mysterious orbit of Planet X, the hypothetical object that has been the source of perhaps more recent controversy than any other

body in the solar system. Harrington, who was leading the search for a 10th planet when he died last January at the age of 50, was the latest in a long line of astronomers searching for this legendary wanderer on the far reaches of the solar system. Now Planet X waits for some other observer to pluck it out of the inky blackness beyond Pluto.

Or spend a lifetime looking for something that isn't there. It's been nearly a century since Percival Lowell launched the first search for what he dubbed "Planet X," an outermost planet whose gravitational pull would account for irregularities thought to exist in the orbits of Uranus and Neptune. When Clyde Tombaugh discovered Pluto in 1930, the Planet X question seemed resolved. But as decades passed it appeared less likely that Pluto was massive enough to cause the other planets' orbital anomalies. James Christy's discovery of Pluto's moon, Charon, made it possible to calculate Pluto's mass precisely and prove that the little planet was far too small—one quarter of one percent of the mass of Earth—to affect Neptune and Uranus. (In fact, Earth's gravitational influence on Neptune is greater than Pluto's.)



RICHARD NOWITZ (3)

Originally called the Depot of Charts and Instruments, the U.S. Naval Observatory is one of the oldest scientific agencies in the country (above). Its library contains over 75,000 volumes, including rare books by Newton, Galileo, Kepler, and Copernicus (below).

"Pluto clearly isn't the planet that was the basis for [Lowell's] predictions," says P. Kenneth Seidelmann, director of the U.S. Naval Observatory's orbital mechanics department. "So that leaves us with the problem of how to explain these perturbations in the orbits of Neptune and Uranus."

The admittedly thin evidence for the existence of Planet X consists almost solely of the supposed quirks in the orbits of these outer planets. In 1846 irregularities of this sort (although far more pronounced) in the orbit of Uranus led a pair of astronomers at the Berlin Observatory to discover Neptune—almost exactly where it had been predicted to exist. Yet a good many astronomers today believe they can explain the wiggles in the motions of Uranus and Neptune without conjuring up a 10th planet.

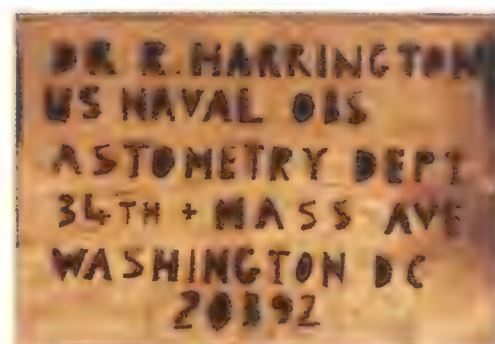
Harrington knew this all too well. A tall, congenial man, he was refreshingly down-to-earth for someone whose pursuits were in the heavens. A postcard perched on a shelf in his office read: "Hav-

ing a Far-Out Time on Pluto," and the furnishings were standard government fare—a hulking gray metal desk, beaten beige walls, 1950s-era bookcases, and filing cabinets crammed with books, journals, and volumes of astronomical charts and tables.

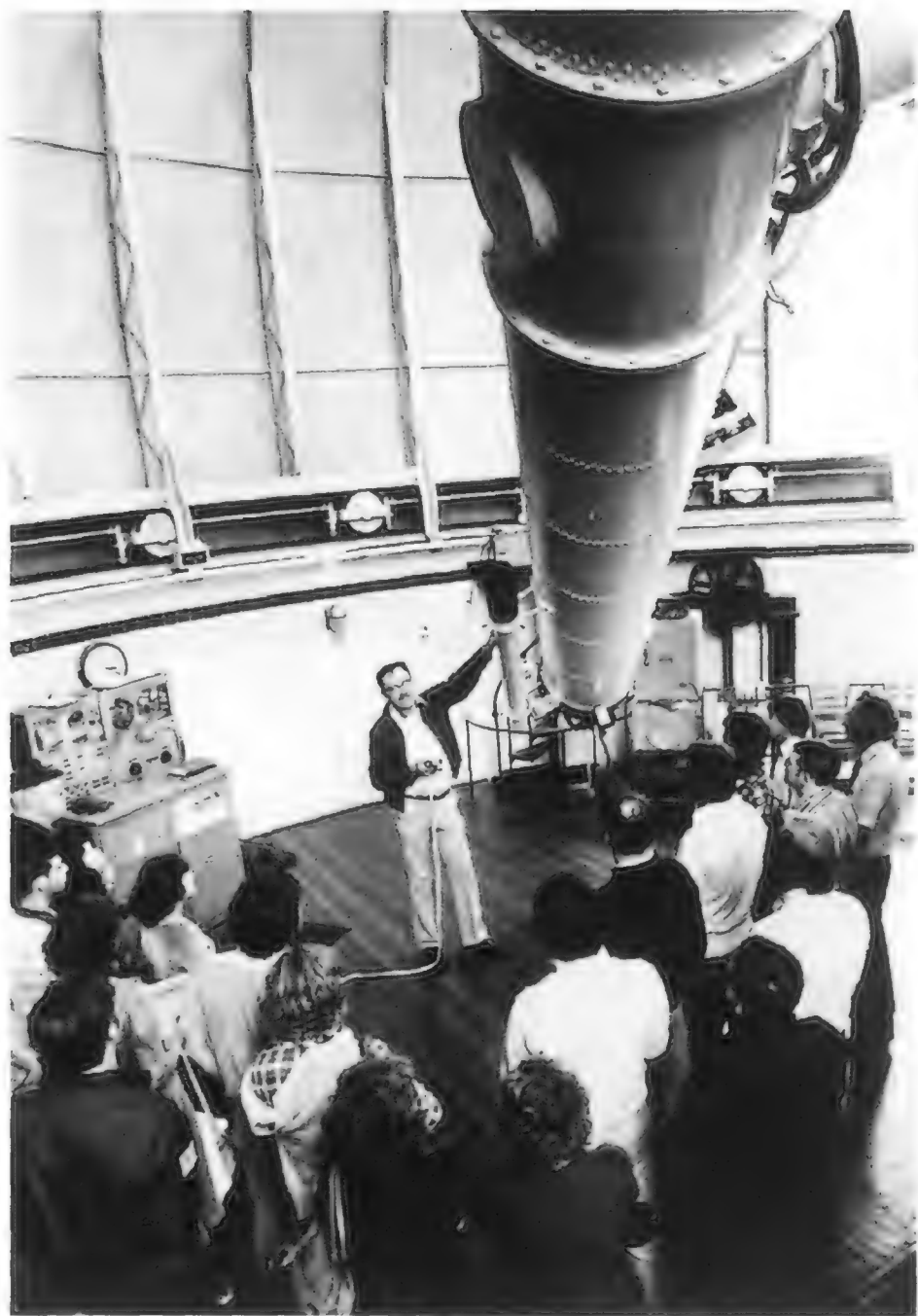
Harrington had arrived here 25 years earlier straight out of graduate school at the University of Texas. Located on a rolling 73-acre estate in the heart of the embassy neighborhood of Wash-

ington, D.C., the U.S. Naval Observatory shares its grounds with the Vice President's mansion, originally the observatory superintendent's home. While it hardly seems the site for such speculative pursuits as the search for Planet X, the observatory has notched its share of significant astronomical discoveries: in addition to Christy's 1978 discovery of Pluto's moon, the two moons of Mars, Phobos and Deimos, were discovered in 1877 when the observatory was located not far from where the Lincoln Memorial now stands.

Today the observatory's eyes have been obscured by the



Shipped from a southern hemisphere observation site in New Zealand after funding cutbacks, the telescope used for the Planet X search returned to the observatory in its packing crate.



Harrington enlightens observatory visitors about the 26-inch refractor telescope, which was used in 1877 to discover the two moons of Mars.

bright lights of the nation's capital; its best-known function is providing official time for the United States. Three dozen atomic clocks, which keep time to within one nanosecond (one billionth of a second) per day, are situated around the grounds and together serve as the U.S. master clock.

The observatory maintains a station in Flagstaff, Arizona, for its deep sky work and now devotes the bulk of its astronomical efforts to astrometry: the mapping of fundamental positions and motions of the sun, moon, planets, and stars. Three large telescopes—a 26-inch refractor, a 24-inch reflector, and a 12-inch refractor, as well as the nation's only operating transit circle (a telescope in a fixed position used for measuring the passage of stars across the meridian)—still do important work. As chief of the equatorial division of the observatory's astrometry department, Harrington studied multiple-star dynamics, brown dwarfs, and precise stellar dis-

tances, but he was most commonly recognized for his work on Planet X.

To determine potential orbits of Planet X that would account for irregularities in Uranus and Neptune, Harrington used a computer to perform numerical integrations of a 10-planet solar system. He believed the planet would be three to five times the size of Earth and some five and a half billion miles beyond Pluto. About as bright as Pluto, Planet X would have an eccentric orbit that took it around the sun every 1,000 years in a plane tilted about 20 degrees from those of the other planets. After literally hundreds of thousands of computer calculations, Harrington narrowed the search to an area of the sky in the northern part of the constellation Scorpius, which is visible only to observers below the equator.

To search the southern sky, Harrington took advantage of a U.S. Naval Observatory station on New Zealand's South Island. On a windy and desolate site nearly a mile high on Black Birch Mountain, an eight-inch double-astrograph telescope took images on single photographic plates. The plates were then sent to Washington for Harrington to examine.

It was a tedious process, essentially the same method Clyde Tombaugh had used to find Pluto more than a half-century ago. The chief tool was a hulking piece of equipment known as a blink comparator, which resembles a library's microfilm reader. Harrington had one of these dull gray brutes in the hallway outside his office. He would take two photographic plates of identical portions of the sky, taken a night or two apart, and align them on the blink comparator's single screen. Any object that had changed its position—an asteroid, a comet, or a planet—between the time the photographs were taken would appear to move as the machine switched between plates.

"I spent 14 years at that blinker and that's brutal," says Clyde Tombaugh, today a retired professor of astronomy at New Mexico State University in Las Cruces. During the years he spent searching the heavens, Tombaugh examined 45 million stars—almost the entire sky visible from the Lowell Observatory near Flagstaff, Arizona.

To demonstrate the enormity of the task, Harrington would sometimes tease a visitor with an invitation to help him find

Planet X. "I think the planet's on this one," he would say as he held up one of the eight-by-ten photo negatives. "Care to find it for me?" When held up to the light, the negative would be absurdly dense with stars, as though someone had shaken fine dust across the film emulsion. The odds of finding a particular object on it—even with a blink comparator—would seem...well, almost astronomical.

Searching through an ocean of star fields, straining to catch one tiny speck among millions that has moved maybe half an inch, is mind-numbing work. Yet for Harrington, every session at the blink comparator held the promise of reshaping the solar system. "I'd scan

a region until my brain went mushy, then come in my office and do something else, then 20 minutes later go back out and scan another region," he said.

Of course, Harrington had no guarantee he would ever get anything but bad eyesight. For all the glamour associated with discoveries, there's nothing at all glamorous about the endless hours of painstaking labor. Compared with the work being done probing distant galaxies for clues to the origins of the universe, solar system astronomy is considered pretty dull fare these days. The search for Planet X is also prone to a variety of errors, the most obvious of which are observational. Astrometry is precision work that can be skewed by the slightest inexactness. Some observations made before the turn of the century have even had to be discarded. That's a major blow, considering it takes an entire orbit to develop a long-term ephemeris—a table that specifies exactly where the planet will be at a given time. Neptune, which circles the sun once every 165 years, has not yet completed an entire orbit since it was discovered. This has shifted the focus largely on Uranus, which circles the sun once every 84 years and has gone around the sun roughly two and a half times since William Herschel discovered it in 1781.

Harrington readily conceded that the quirks in Uranus' orbit are relatively small. "The effects I'm working with are

about a hundred times smaller than the effects used to predict Neptune," he said. "I've played the observational game long enough to know that there are any number of perfectly possible alternative explanations for [orbital irregularities]: atmospheric turbulence, miscalibrating where your crosswires are, some error in your star positions—there's just all kinds of things that can sneak in there and cause problems."

"It doesn't look very promising," says Tombaugh about

the search for Planet X. "but then you can't say no." The latest theories about the formation of the solar system envision little beyond the giant outer planets larger than asteroids or comets. The dis-

For Harrington, every search session held the promise of reshaping the solar system.

covery last August of 1992 QB₁, a reddish comet-like object 120 miles across and currently located some 3.8 billion miles from Earth, supports this thinking. The object is perhaps the first evidence of the existence of the Kuiper belt, which is believed to be one of two sources of comets. However, the possible discovery of this comet belt offers no further evidence either for or against the existence of Planet X, except to confirm that the solar system does not stop at Pluto's orbit.

Other evidence weighs against the planet's existence. In 1983 NASA launched an infrared astronomy satellite to survey the sky with a 22-inch telescope. Some astronomers contend that if a 10th planet were floating around in the far reaches of space, IRAS would have detected it. P. Kenneth Seidelmann disagrees. "I thought that was a great idea until a friend of mine and I did more careful work on what the observational characteristics for IRAS were," he says. "They're not sufficiently accurate positionally to let you know you've discovered a planet. There's really no way to do it from the IRAS data."

The latest evidence against the existence of Planet X is the work of E. Myles Standish Jr. An astrodynamacist at the Jet Propulsion Laboratory in Pasadena, California, Standish leads a group that plots the motions of the planets so JPL can calculate the thread-the-needle flybys performed by space-



craft like Voyager 1 and 2. He recently reworked the orbital residuals—the difference between a planet’s predicted position and its observed position—for Uranus with one important difference: his calculation of the mass of Neptune reflected new information Voyager 2 had sent in 1989.

Standish says that when he used the proper mass of Neptune and then readjusted the orbit of Uranus, lo and behold, the residuals flattened out. “It’s terribly simple,” he says. “So the question is, How come nobody else did this? When I went back and started reading the Planet X papers a little more carefully, I saw that people either didn’t use the proper mass for Neptune or didn’t recompute the orbit of Uranus based on the new mass, or some combination of the two.”

Seidelmann insists he did try a range of different masses for Neptune, and Harrington rejected the assertion that the new masses really eliminated the Uranus residuals. “It’s one of those half-empty or half-full arguments,” he said. “Standish looks at his results and says the glass is half-empty, that the effects have disappeared entirely. I look at the same plot and see the glass half-full—even though the effects are smaller. I can still see them.”

“I quite frankly don’t think that the searches for Planet X are ever going to produce anything,” says Brian Marsden, director of the International Astronomical Union’s Central Bureau for Astronomical Telegrams, the main clearinghouse for astronomical discoveries. He dismisses the notion that a lone astronomer today can make a major astronomical discovery the way Clyde Tombaugh did in 1930. Marsden believes that Standish’s calculations will be the final word on Planet X.

“Brian is paid to be a skeptic,” countered Har-

rington. “Just like Myles has an obligation to go to his boss and say, ‘We’ve got the solar system under control. Here it is. Now you can fly your mission.’ For me to come along and say, ‘Aha, you’ve overlooked the 10th planet’—that makes them look bad.

“Besides, Brian’s just plain wrong. Relatively little has been done in the southern hemisphere. It’s been photographed once and we’ve got the entire collection of photographs here, and no one has sat down with them and done this blinking.”

As committed as he was to finding Planet X, Harrington remained remarkably open-minded, and he was candid about his chances of being wrong. He enjoyed sparring intellectually with his critics over beers at astronomy conferences. Through the years Harrington had coined a variety of playful names for Planet X. He once told a journalist from the magazine *Science* that if and when Planet X was discovered he planned to name it “Panacea,” an appellation suggesting that Planet X might be the remedy for at least one big question about the solar system.

Searching for a 10th planet was, by necessity, a part-time pursuit for Harrington, an extracurricular activity that he had to sandwich in between his regular duties. “I can’t do it any other way,” he said, “given that this is something of rel-



atively little interest to the Navy and I can't make any stronger case for it."

Late in 1991 Harrington's search for Planet X fell victim to Department of Defense cutbacks. When the Navy indirectly cut its funding, the eight-inch double-astrograph telescope that Harrington had been using in New Zealand was packed up and sent back to Washington. Last summer it sat on the Naval Observatory loading dock in a packing

crate wrapped in bright blue plastic that collected puddles when it rained. Harrington leaned against the crate and pondered the question of how he had felt when they closed down his telescope in the southern hemisphere. He thought for a moment, then replied: "Like somebody had taken a two-by-four and hit me in the back of the knees and knocked my feet out from under me."

Still, he had been a civil service employee with the Navy long enough to understand the vagaries of military politics. Once, while demonstrating the observatory's 26-inch refracting telescope, he showed how a speckle interferometer transmits the viewing field directly onto a computer screen, eliminating the need for an ancient eyepiece. "We only use the eyepiece on very special occasions," he said wryly. "Like when the admiral's daughter is visiting."

His work was subject to the same whims, and though he rarely admitted it, that frustrated him. "Be nice to the Navy," he'd urge reporters, mindful of the public posture he had to



DOUGLAS MERRIAM

maintain. But in unguarded moments, he was very clear about the reason his search for Planet X had little official support: "You can't kill people with it."

Despite the fact that the 10th planet theory seemed increasingly out of sync with current thinking about the solar system, Harrington remained steadfast. He had a proposal under consideration at NASA to get on a more powerful telescope at the Cerro Tololo Inter-American

Observatory in La Serena, Chile. Given the overwhelming odds against success and the skepticism that greeted his work, what kept him in pursuit of Planet X? Aside from the obvious allure of discovering a new planet, Harrington seemed caught up in the excitement of the chase itself. "A lot of science, astronomy included, you're not out actually looking for something—you're mostly collecting data about things that you already know exist," he said. "Very rarely do you get a chance to do something new."

"Now obviously you can't say: 'I think I'll go out and discover something today.' But if I blink plates today and don't find anything, there's always tomorrow, or next year. And this year my telescope's out on the loading dock, so there isn't this year. But maybe there's next year."

It was not to be. When Percival Lowell died in 1916, the search for Planet X was suspended for many years. Now that Harrington is gone, the phantom planet may never have another strong advocate. "I'm almost a lone voice in the wilderness," Harrington said. "There are a lot of people who think the evidence doesn't show anything significant, and they could very well be right. I've never given this thing better than 50-50 odds of existing. But as long as I can turn around and give you one reason why it might be there, I don't think we can afford not to look."



Clyde Tombaugh (above) was only 24 when he discovered Pluto in 1930 at the Lowell Observatory near Flagstaff, Arizona. Hoping for a similar discovery, Harrington developed computer models that portrayed Planet X in an eccentric orbit that took it around the sun every 1,000 years at about 20 degrees to the plane of the other planets (left).



Pictures from St. Petersburg

Images from a forgotten archive of photographs portray the earliest years of Russian aviation.



PHOTOGRAPHS COURTESY SLAVA OLSHEVSKI

By Slava Olshevski

You would never find the State Archive of Cinema, Photo, and Phono Documents of St. Petersburg if you didn't know the city like the back of your hand. A friend of mine who had been looking for photos of his grandfather, a pioneering Russian pilot in the period before World War I, stumbled upon

Cossack captain Tkachev, a fighter ace, poses with his hand on the prop of a Morane-Saulnier in 1914 (above). Identities of the other individuals are unknown.

Russian nobility gathered in St. Petersburg for the nation's first aeronautical exhibition, held from September 8 to 29, 1910 (opposite). The goateed grand duke Alexander Mikhailovitch is in profile.

In 1911, Russia held its first international aeronautical exhibition in this riding arena. Today the building draws tourists with a flea market hawking Russian art.





A pilot identified as "A. Pouare" prepares to depart with a well-wrapped passenger at Russia's fourth airshow, held in St. Petersburg from April 29 to May 6, 1914 (above).

A flight school established at Baku, on the Caspian Sea, trained pilots to operate flying boats. This M-10, powered by a 100-hp Gnome from France, was designed by Dimitry Grigorovitch and built in early 1916 (below).

A Blériot XI under the command of a pilot named Vasiliev prepares to depart from a hazy St. Petersburg field during the second international airshow, held from May 14 to 22, 1911 (right).





the place. When I started looking for it about two years ago, it took me three laps around the same block before I noticed the small sign.

A dour security policeman guards the entrance, and once inside, you must fill out numerous forms in order to obtain your maximum limit of 50 prints a year. You search through small prints made from each negative, and there's a registration code number and a brief description of each photo. The rooms are small and silent except for the rustle of papers being sorted by several

women, and your every move is watched. There are no men on the staff—the state salary is probably too low.

But I forgot everything around me as I began digging through the files. Almost all the people who were alive in the early 1900s are gone. The rare survivor can tell you many fascinating stories, but nobody can show you what that world looked like—all those primitive airplanes and quaint automobiles! You can find some of them in museums, but something is missing: the look of all those



A reconnaissance aircraft resembling a Farman but identified as a "Meller II" had a 100-hp Gnome engine—but not for long. It fell off and destroyed a Sikorsky airplane parked at the airport below, but the pilot landed safely (above).

A forlorn Igor Sikorsky (right) surveys the extensive damage done to one of his aircraft when the engine (opposite, in small photo) from the Meller II smashed through one wing. The Sikorsky airplane was never repaired.

Powered by four 100-hp engines, the "Russian Vityaz" (Russian Knight) exemplified Russian designers' early

interest in very large aircraft. Its engines are running, and designer Sikorsky is standing in the nose next to the large searchlight (right).





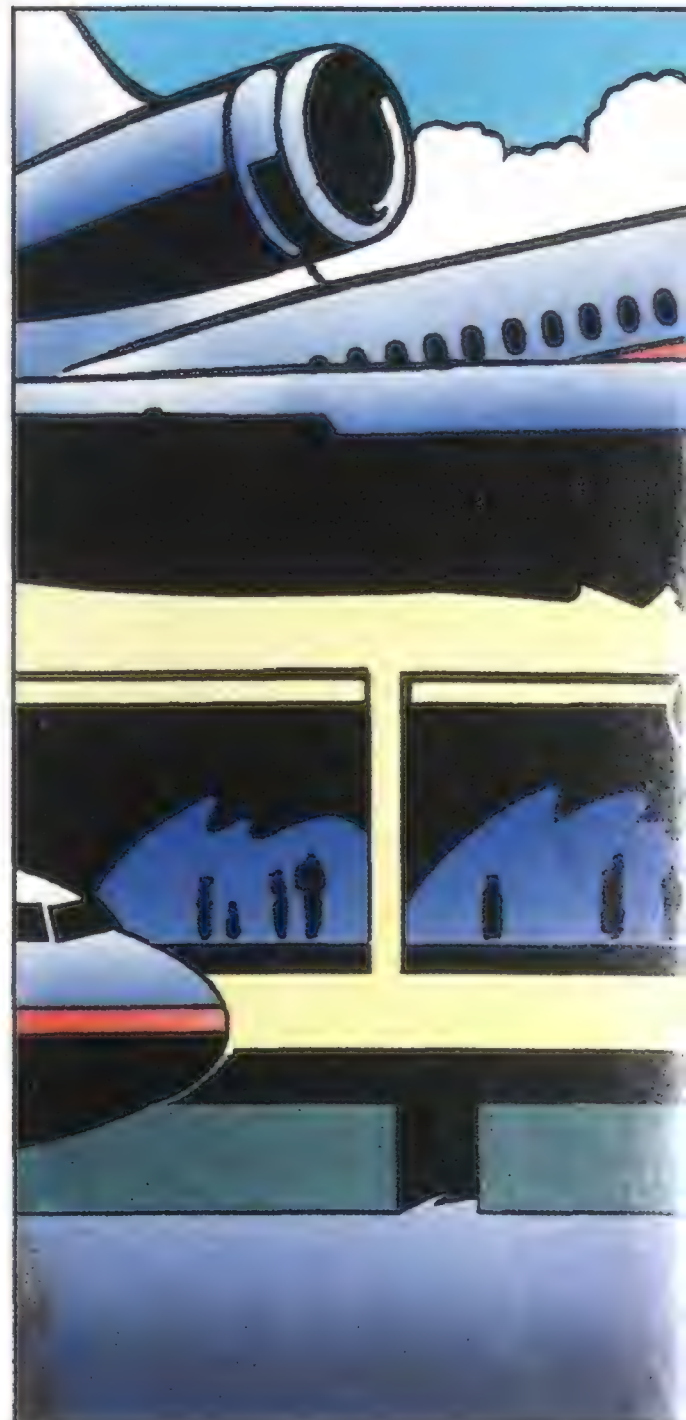
people who were witnessing the strangest of events as the first airplanes took flight.

Now the past was opening up before my eyes. And later, working at the library of the Academy of Science, I learned more: the events, the dates, even the names of some of the early pilots.

The history of aviation in Russia is a long one. A Russian airplane design narrowly missed beating the Wrights for the title of first to fly. As early as 1908, representatives came from France to demonstrate airplanes. They inspired an avalanche of Russian airplane designs—hundreds a year. And the government, searching for military

applications, poured money into the new industry, with Grand Duke Alexander Mikhailovitch the leading patron. During World War I, when the airplane proved itself, Cossack officers became the leading aces of the war.

My two-year effort to collect these photographs has brought to light images that have not been seen for decades. I am pleased to share this small selection. ➔

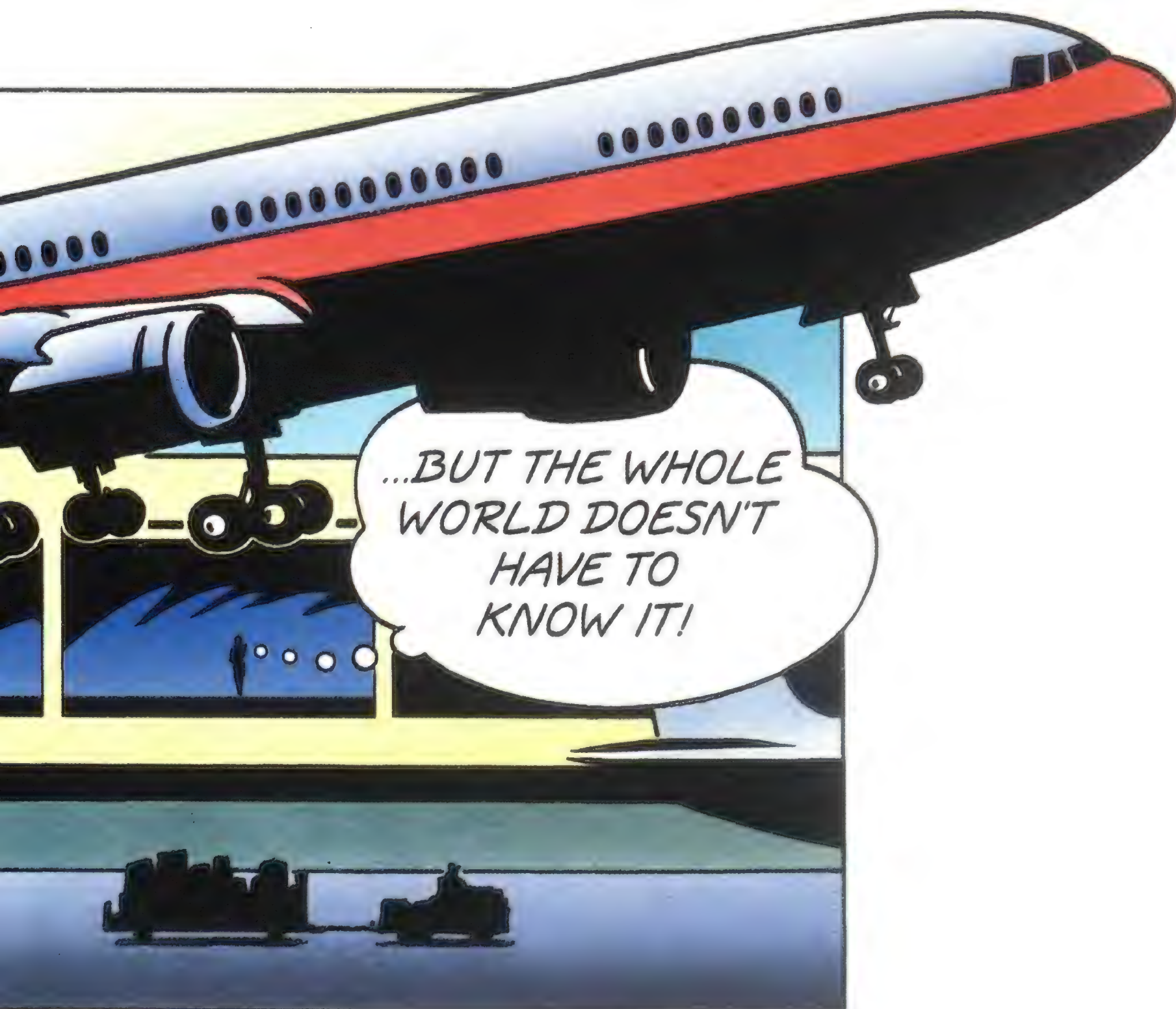


No more "I'm Cheryl. Fly me."
No more hot pants.
Say goodbye to stewardesses
and hello to...

THE FLIGHT ATTENDANTS

Snow and ice covered the grounds of United Airlines' flight attendant training center in Elk Grove Village, a suburb 16 miles outside Chicago. A bitter January wind swept over the eight-story building, but inside the mood was warm and festive. It was graduation day for 38 students who had begun United's rigorous training program seven weeks earlier.

By 11:00 a.m. friends and family of the soon-to-be flight attendants had filled the auditorium. Then the sound of dozens of black pumps clip-clopping across the floor announced the arrival of the graduating students. As required by the voluminous United dress code, they were all immaculately turned out. The three men all had short haircuts and wore wrinkle-free navy blue suits. The women—most of them slim, white, and young—wore navy blue blazers



and below-the-knee skirts. All the women sported full makeup and wore light-colored hosiery, and those with long hair had pulled it back into the regulation ponytail.

Following a pep talk by a United training executive, it was time for the climactic moment. One by one each new flight attendant walked up to the stage to have someone—usually a parent or husband—pin on his or her wings. During the entire ceremony, soft music played over the speakers, the lyrics, though barely audible, aimed at both the new flight attendants and the audience: “When you’re friendly, you do things for people. Fly the friendly skies. United Airlines.” Four graduates in the first row of seats burst into tears; luckily someone had remembered to bring a box of tissues.

After a brief slide presentation, the

training coordinator stepped up to the podium, smiled like a proud den mother, and said, “Flight attendants, prepare for departure.”

The job they were departing for is one that is continually evolving. Sixty years ago the first flight attendants were responsible for swatting flies in the cabin before takeoff and cleaning passengers’ shoes. Today, flight attendants spend much of their time serving meals, cleaning up the galley, and handing out pillows and blankets. From a passenger’s perspective it may appear a somewhat cushy line of work, but—the pageantry of United’s graduation ceremony notwithstanding—many flight attendants say that the job is neither glamorous nor sexy. “It’s not *Coffee Tea or Me?*” says one flight attendant, referring to a 1967 book that portrays the lives of stewardesses as one big bowl

by
Diane
Tedeschi

Illustrations
by
Steve
McCracken



of cherries. (When not flying, main characters Trudy and Rachel—and their many stew roommates—constantly drink, party, and sleep with pilots and businessmen.) Some 20 years later, the sexual innuendo continues; the September 1992 issue of *Playboy* ran a pictorial of scantily clad flight attendants and described them as “well dressed, highly competent, often extremely attractive women who also seem to be in really good moods. They are never, never, never afraid of flying.”

Advertising campaigns mounted by various airlines in the 1970s only helped foster the image of sexiness. “Flight attendants are probably the only group that [was] ever formally sexually harassed by the company,” says David Melancon, director of communications for the Association of Flight Attendants, a 30,000-member union headquartered in Washington, D.C., that represents employees of 19 carriers, including United, USAir, and Alaska Airlines. “I mean, ‘Fly me, I’m Cheryl.’ That was sexual harassment.” The “fly me” advertising campaign, undertaken in 1971 by the now-defunct National Airlines, set a new low even for that time. In 1974 Continental came up with “We really move our tail for you.” And over the years women have been forced to wear everything from paper mini-dresses and hot pants to British wench outfits.

The airlines apparently thought all passengers were lecherous businessmen; stewardesses were forced to re-

tire when they turned 32 or got married, whichever came first. But though the practice probably encouraged customers to think of stewardesses as sexually available young women in search of husbands, the airlines also had an economic incentive to retire stewardesses at a young age: the company didn’t have to pay pensions.

Over time, the “stewardess” has been subtly transformed into the “flight attendant.” According to the AFA, the typical flight attendant in 1992 was a college-educated, 35-year-old woman with a family, and the job has become a lifelong career with full company benefits. The average tenure of a flight attendant today is 10 years, and it’s not uncommon to find people with 25 years of service. Men have joined the ranks and are enduring stereotypes of their own. Yet even as society’s attitudes have changed, the image of the flight attendant has stayed much the same.

Many flight attendants have a certain look: long blonde hair, whippet-thin figure, polished red fingernails, and lots of makeup—what one flight attendant calls the “Barbie doll image.” It’s a holdover from the days of stewardesses—when the airlines regulated their weight and appearance with drill sergeant precision. The airlines no longer place such a strong emphasis on appearance, but that’s less because they’ve gained in wisdom and more because they’ve lost in court. Thanks in part to years of litigation, much of it

spearheaded by the AFA against airline management, flight attendants are now a much more varied lot. A 1971 court case, *Diaz v. Pan Am*, made it illegal for airlines to refuse to hire men. And as recently as 1989, the now-defunct Pan Am was faced with a lawsuit that asked for more generous weight allowances.

Not all of today’s flight attendants have The Look, but physical appearance is still a factor in getting hired. Airlines are still seeking a “professional image” and “weight in proportion to height.” “A nice sharp image—that’s important to us,” says Ray Boyle, manager of flight attendant employment for United. “Not that raving beauties is what we’re after—just a good, crisp, clean, well-groomed image.” And it’s true that many flight attendants are far from flawless. “I think they just have to be able to take the human attributes that God gave them and make the very best of them,” says United training executive Jeannie McNeil. “We teach the women the very best use of cosmetics to enhance their looks.”

Gone are the days when women were patted on the backside to ensure they were wearing girdles, suspended for wearing the wrong color nail polish, and restricted to wearing only white underwear. Now, depending on the airline, flight attendants can wear glasses, have a chipped tooth, or suffer from a blemish. Tolerance varies from company to company. Though airlines have faced lawsuits over the issue of weight, some still require their flight attendants to adhere to strict standards or face suspension, while others accept the weight gain that comes with aging. And the smaller commuter and regional airlines, which might hire only 35 flight attendants for the entire company, can be even pickier than the larger carriers.

A flight attendant won’t be hired on looks alone. Also important is a pleasant personality, one that “anticipates passenger need,” as those in the industry like to say. Although McNeil says United looks for people who have a “pleasing physical image,” she also wants people “who have a positive service orientation, who don’t feel belittled by the fact that we are a service organization and what we’re providing is service.”

Deborah Wagner, 27, a United flight attendant based in San Francisco, knows about the requirements for the job. Born and raised in Omaha, Nebraska, Wagner has a wholesome prettiness, but she does not have The Look, and she worried that this would keep her from working the friendly skies. When she attended a United open house in Omaha she felt out of place among a group of mostly younger women, many of

worked as an emergency room nurse before becoming a flight attendant. When asked why she thinks United picked her, she says, "I know that I'm a people person and they [airline management] know darn well that every single minute of our job we're dealing with people. If you're really intimidating on the plane, no one's going to ask you for that drink of water to take their medicine because they think you're go-

their airline passes, flight attendants can travel all over the world for next to nothing. "To be mobile, to be able to go to a party in L.A. your girlfriend has this weekend," says Wagner. "I don't do those things, but I *could* do those things, go anywhere I want for whatever reason I want." And despite all protests to the contrary, people are still lured by what they perceive as a glamorous profession. You can see the hunger



whom worked in the fashion industry or as cosmetics counter salespeople. Recalls Wagner: "I came home and I said 'Forget it. Just forget it. It's just not you. They don't want you.'" But she was the only person selected for a second interview.

"I thought it was a glamorous-type position, something that only Miss Americas did because I hadn't had much flying experience," says Wagner, who

ing to rip their head off. But I think they're also not looking for cutesy. They're looking for substantial people with personalities."

They have a lot of people to choose from. Last year, United interviewed 19,000 people all over the country for its coveted 1,300 openings. Obviously, there's something appealing about being a flight attendant.

The job does have its perks. With

for glamour in the faces of the young women walking purposefully about the lobby of United's training center at nine o'clock on a Monday morning. Even in the student cafeteria, there's a continuous buzz of excitement as people gather around tables and talk shop. And while the curriculum includes such practical courses as accounting and aircraft familiarization, no one seems to mind the mandatory four-hour cosmetics

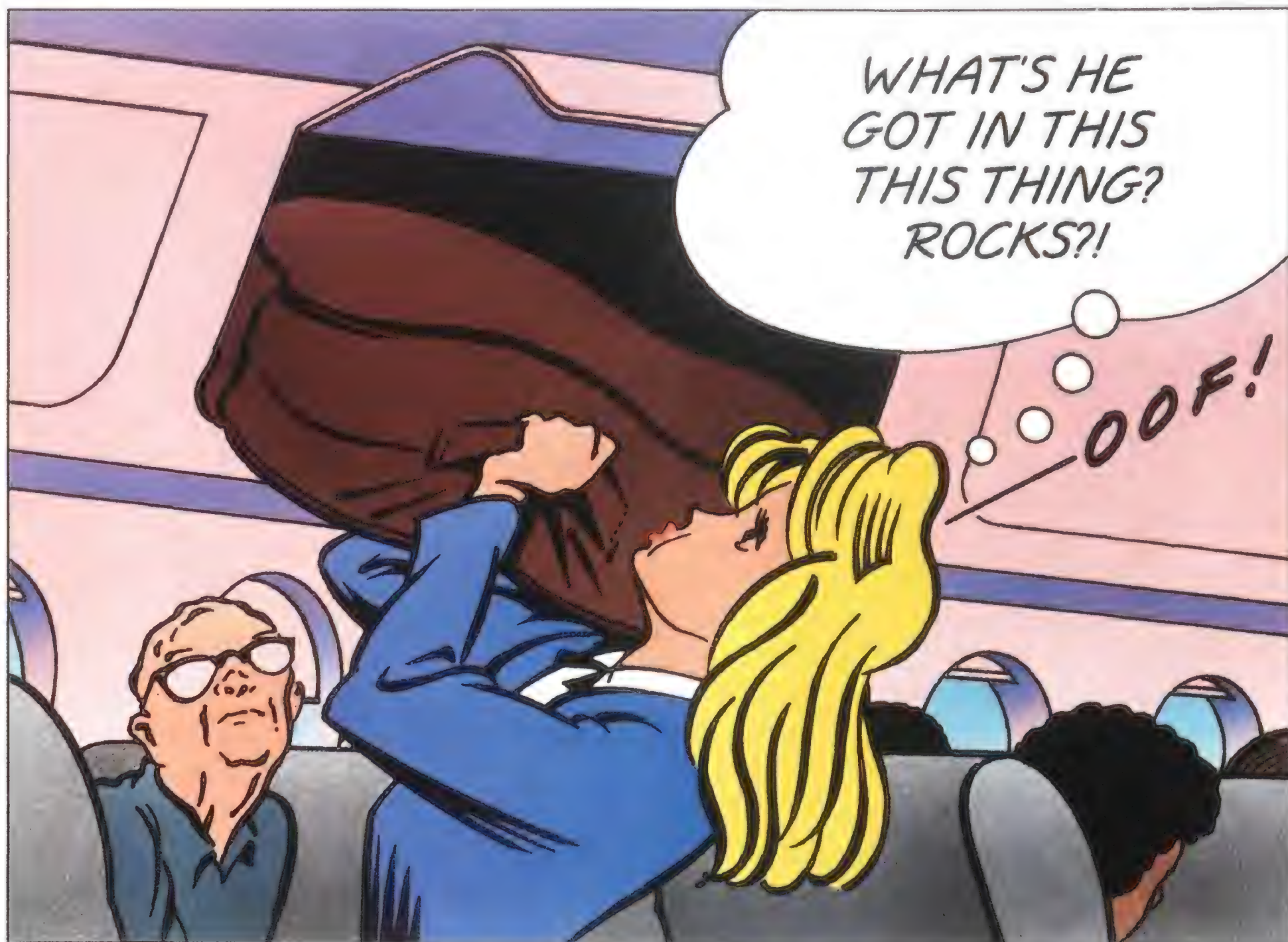
class. (United requires male trainees to attend only the first hour to learn about hygiene.)

The job does have drawbacks—like the inconvenience of always living out of a suitcase. Deborah Wagner lives with her parents in Omaha, but since she is based in San Francisco, she shares an apartment there with 11 other United flight attendants. “We come and go so much that I’ve never been there

I might be alone the whole time.”

Then there’s the frustration of dealing with inexperienced passengers. “People are bringing on unbelievable things,” says Fred Casey, 40, a USAir flight attendant now serving as the AFA’s vice president. “I’ve had a lawn mower brought to the gate of an airplane—a lawn mower with gasoline in the tank. I’ve had babies put in overhead bins. Babies put up underneath the seat. We

the cabin crew remained the same. And the later 737’s improved engine performance made for faster flights, which reduced the amount of time flight attendants had to perform the same service. Flight attendants are well aware that post-dereg competition has forced airlines to cut their costs and add seats. Says the AFA’s Casey: “All we say is just give us the extra bodies we need to service those people and insure that



[when] there’s more than four people at a time,” says Wagner. “We only have one bedroom, so some people sleep on the floor in a sleeping bag, and some people sleep in the bedroom. It’s interesting.” And sometimes it’s lonely. “If I’m on call for eight days,” she says, “I could sit for five in that apartment with nothing to do [but] read my book, watch the TV, take a walk, and then leave. But even when I’m there five days in a row,

said, ‘You have to stow your personal items.’ And I saw this lady put the baby in the overhead bin and I said, ‘Ma’am, you can’t do it.’ And she said, ‘Well, you said to stow it.’ ”

Flight attendants have also felt increasing stress since Congress deregulated the airlines in 1978. A pre-deregulation Boeing 737 on one airline had 98 seats. After deregulation it was reconfigured for 119 seats, yet the size of

they’re safe.”

Their role in making aircraft cabins safe is perhaps flight attendants’ most important job, and it’s one that goes beyond preflight seatbelt demonstrations. Before earning their wings, flight attendants must master first aid techniques such as the Heimlich maneuver and cardiopulmonary resuscitation. Most importantly, they must be able to evacuate an airplane in an emergency.

Their training has saved lives. On April 28, 1988, an Aloha Airlines 737 was flying at 24,000 feet over the Pacific when a 20-foot section of its upper fuselage peeled away. One flight attendant was sucked out of the aircraft; another was knocked unconscious. Despite a continuous blast of air, the remaining flight attendant crawled up the aisle, helping passengers locate and don their life vests. She also cleared debris from the aisle and helped injured passengers. After the airplane landed, she directed a quick but safe evacuation.

"It isn't just a glamorous job in the sky," says Casey. "We are safety professionals and we do have an agenda out there." Over the years, the AFA has successfully lobbied Congress and the FAA for a smoking ban on all domestic flights, a carry-on bag limit of two per passenger, non-slip floors in the galley, and a requirement that flight attendants be seated during taxiing.

Flight attendants are also under increasing pressure to sell the airline itself. "I view the job as very demanding," says Maria Miller, 36, a United flight attendant based in Los Angeles. "You're catering to people with extended backgrounds from all areas. But you are trying, first of all, to sell a product. You're trying to gain repeat business."

But how many passengers really choose an airline based on the service



they get from the flight attendants? Vicki Pryor, a former flight attendant who is now United's manager of in-flight services training, acknowledges that airfare and flight schedules are what really influence the purchase of a ticket. But she says that according to United's research, 24 percent of passenger choice is influenced by the in-flight experience, which she believes is shaped almost entirely by the flight attendant. Maria Miller agrees: "It's real competitive out there, and with the economy such as it is today, we really have to cater to the customer in order to get that repeat

business because they can go somewhere else."

Unfortunately for flight attendants, their increased role in selling the airline has not been rewarded with greater pay and recognition. "As a matter of fact," says Casey, "on almost all of the recent contracts we've opened, because the airlines are in such financial straits, they've actually asked for concessions." The starting salary at United is \$17,000 a year plus about \$3,500 for meals. (The airline picks up the tab for hotels, ground transportation, and uniform cleaning.) For the first five years, salaries inch along, but after the fifth year they begin to pick up. After 14 years, a United attendant can expect to be making over \$40,000, depending on the number of hours flown. A senior attendant flying international routes with lots of overtime can earn close to \$50,000 a year.

Yet the union feels that airline management doesn't always take flight attendants seriously. Even though the attendants are with the passenger longer than any other airline employee, "they are perceived as the least important," says Casey. "They're perceived as the 'girls in the back'—the young things who are just going to be here for two or three years, maybe find a husband on the plane."

Please don't refer to Martin Calhoun as one of the "girls in the back." Calhoun, 39, is one of the male flight attendants who currently make up about 15 percent of the workforce. An attendant for Alaska Airlines for ten years,





he is in this business to stay. In the beginning, "it's new and it's glamorous," says Calhoun, who has a second job producing comedy bits for a Seattle rock radio station. "And of course you travel a lot and you get to stay in very nice hotels, something that is probably above most people's personal budget. But after a few years, like any other job, it becomes a job. I look at [it] now as: number one, income and benefits, and then after that, a job that has very flexible scheduling hours so that I can pursue another job."

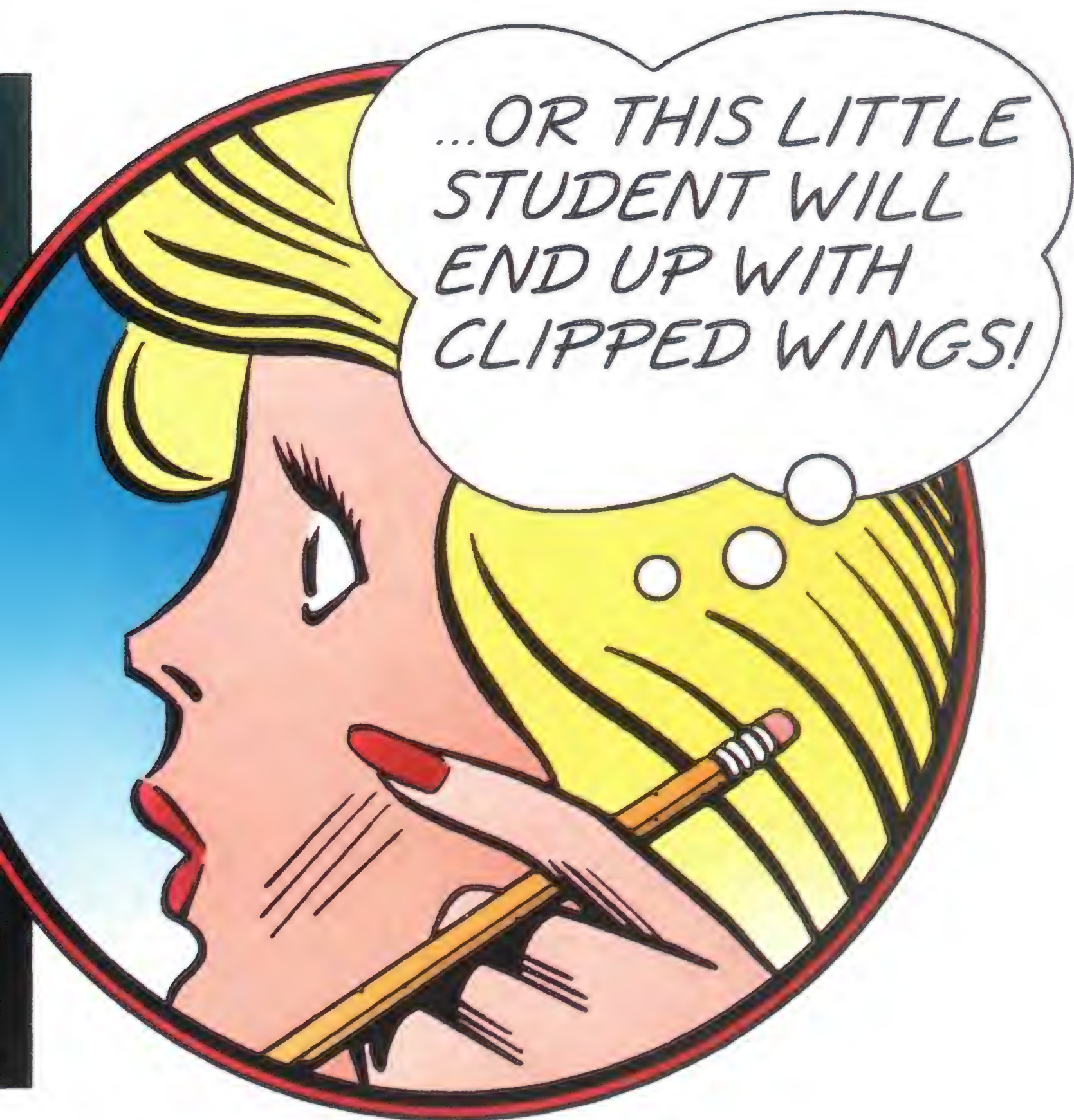
Like their female colleagues, male flight attendants are subject to stereotypes—among them that any man work-

ing in a woman's field must be effeminate or gay. That's not to say that there aren't many gay men working successfully in the cabin. One United training executive insists that gay men "make wonderful flight attendants. They're very service-oriented."

Pilots, however, long used to having their meals served by female flight attendants, have often resented a male presence in the cabin crew. "We still fight harassment cases from pilots," says the AFA's Melancon. "There's still friction out there." Says Casey: "I personally didn't feel a lot of the discrimination. There [were] one or two guys in the cockpit who had an attitude at

first. But once they found we treated them professionally, they were fine."

Male flight attendants are also sometimes treated differently than their female colleagues in the cabin. Calhoun says that older passengers "tend to look at the male flight attendants and assume that we are the ones in charge." But he says that younger passengers treat men and women attendants with equal respect. Fred Casey tells a different story: "I watched two [female] flight attendants ask a passenger to put his briefcase up underneath the seat. And he said, 'Yeah, yeah. I'll get to it.' And I walked over and said, 'Sir, would you put your briefcase up,' and it went



right under. Not a 'Yeah, yeah.' It just went right under."

Male and female, gay and straight, young and old, black and white, married, divorced, pregnant: many kinds of people now work as flight attendants. Does airline management support today's diversity? It depends on whom you ask. "I don't think you'd find a person in United management that would ever suggest we want to go back to where we were 25 years ago," says Ray Boyle. But, says Casey, "Management would say that because that's legally the safe thing to say. If that were true—if they really wanted a mix—there'd be a larger mix." What seems obvious is

that youth, beauty, weight, and gender are not the important factors if airlines just want to provide gracious and intelligent service for their passengers—who seem ready to embrace a broader definition of what a flight attendant can be. In 1991, American Airlines began recruiting flight attendants over the age of 50, and its passenger surveys are showing that many fliers feel more comfortable with an older, more mature crew.

Amy Spreeman, a spokesman for Northwest Airlines, puts it simply: "You know, our customers are not all 20-year-old women. So why should our flight attendants be?" —

STAR TREK: THE FINAL CURTAIN

A look back at the Smithsonian's most popular exhibit, as seen through the eyes of the volunteers who staffed it.



by the Editors of *Air & Space*/Smithsonian

Photographs by
Caroline Sheen

You don't often see the words "Smithsonian Institution" and "crowd control" in the same sentence. Though the museums on the Mall are among Washington, D.C.'s biggest tourist draws, the institution has always been able to manage its tides of visitors with a relatively small number of security guards. But in February 1992 the institution faced a challenge in crowd management that was entirely different, in both scope and intensity, from anything it had faced before: that month, the National Air and Space Museum opened

an exhibit documenting the pop culture phenomenon known as Star Trek.

The exhibit was housed in the Museum's art gallery. It's a generous exhibition space, but Museum officials knew that, given the hold Star Trek has exerted on the public, no single gallery would accommodate at one time every Trekker who'd make the pilgrimage to the exhibit. So a pass system was set up and the word went out: the Museum was looking for volunteers to put in two four-hour shifts per month helping to manage the flood of visitors.





Close to 300 good-natured souls stepped forward. Over the ensuing months, they put up with questions ranging from “My husband has a pacemaker, can he go in?” to “What about the bald guy on the new show?” They also witnessed an uncommonly wide range of human behavior, some inspired by Star Trek, some less easily explained. Shortly before the exhibit closed last January, we asked some of the volunteers to recount their more memorable moments on Trek duty. These are their stories.

The volunteers on duty that day called him “the Captain.” Fully costumed, the visitor had clearly taken elaborate pains to look every inch the image of Star Trek’s manly leader, Captain James T. Kirk. Armed with a video camera, the man went about methodically documenting every part of the exhibit he could, even the undersides of the models of the starship *Enterprise*, which he photographed while lying on his back.

The Captain’s visit, most volunteers agreed later, was a record-setter. Though many Trekkers took in the artifacts slowly, savoring everything from Spock’s ears to McCoy’s scalpel, the Captain’s tour was probably the longest—five solid hours.

When it came to a devotion to Trek trivia, however, the volunteers often proved themselves every bit the equal of the visitors. Lorenzo Heard, a 34-year-old record store employee, has been watching Star Trek since he was eight, and he says that none of the exhibit’s visitors ever came up with a trivia question he couldn’t answer. On his first day of volunteering, “this guy walked up to me and said, ‘Who was the woman that played Robert Lansing’s sidekick?’ I looked up and I said, ‘Teri Garr.’ He said, ‘You’re right.’ I said, ‘Of course I’m right.’” (Heard

Visitors to Star Trek often lined up for passes hours before the Museum doors opened at nine in the morning. Close to a million people viewed the exhibit, some of them in costume (opposite).

explains that for “somebody who’s really into the show, that’s an easy question.”)

Though the vast majority of the visitors were polite people with an enviable amount of patience, volunteer Joe Rauscher, a 48-year-old financial specialist for the Environmental Protection Agency, conceded that “there were instances where I would have groups of people who were rowdy, or not waiting in line, or causing problems.” He found, however, that a few carefully chosen words could work wonders. “If I said something like ‘There are Starfleet regulations prohibiting that type of behavior on the transporter, or in the Museum,’ they’d look at me and it would be like the anger, or the hostility, or the meanness would disappear,” Rauscher says in wonder; “I mean, they would not call my bluff.”

Some dissatisfactions weren’t so easily quelled. Recalls Marilyn Kozak, 39, a special events staffer at the Museum: “The angriest people we saw would be people who did not



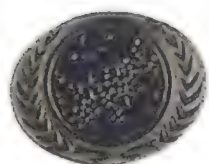
In the 27 years since its debut, Star Trek has become a marketing phenomenon. The Museum’s gift shops offered fans a selection of Trek-theme merchandise.

know the pass system, would cruise in about two or three o’clock in the afternoon, and the passes would be gone, and they’d be really, really angry.”

Even those familiar with the rules could get mighty irritable. “People would get in line in the morning sometimes as early as six thirty, seven o’clock to get in the door at nine to get a ten o’clock pass,” says Kozak. And some who didn’t get tickets until eleven found that the earliest admission they could secure was four o’clock—a five-hour wait. Kozak recalls that the longest line to accumulate on her beat was about 700 people. “A lot of times we’d try to sit



During its 11-month run, which was extended by five months due to popular demand, the exhibit became a shrine for the show's most ardent fans (above). Among them were members of IDIC ("Infinite Diversity from Infinite Combinations"), who wore jewelry displaying the group's symbol (below right). Other Trekkers were seen wearing pins sporting the United Federation of Planets logo (bottom).



downstairs—we'd call it the abuse chair—I would sit downstairs for a couple of hours in the afternoon just trying to appease them," Kozak says of the crankier visitors. "I'd say, 'Well, I'm going downstairs and take a couple of hours of abuse.'"

During her volunteer stint, Kathryn Moore, a kindly 51-year-old aerospace computer specialist, took only a couple of minutes of abuse, but those particular minutes were altogether too long for her taste. "We had a man who came in who was very big and athletic," she recalls. "He did not have a pass, had not understood that there were to be passes. He said, 'I drove all the way down here from Boston, stopped off in Washington to see this on my way to Florida....' I said, 'Wait over here till I let this group of people in.'" Moore walked away for a moment to appraise the line and see what

she could do to squeeze the man in. But by the time she returned, the visitor had evidently become convinced she was trying to ignore him. "He got me by the front of my shirt," recounts Moore, "and had me up off my tiptoes."

Fortunately, a Museum security guard happened to look over and take in Moore's predicament, and within seconds he had inserted himself between the frightened volunteer and the enraged visitor.

Those visitors who kept their heads when passes were scarce sometimes found other ways of getting into the exhibit. Jonathan Kosarin, a 41-year-old attorney with the U.S. Navy, recalls one dramatic example: "I had a couple who was going on a plane back to Miami the day Hurricane Andrew

hit. And they were about three hours away and they showed me their plane tickets; I mean, this was legit. They said, 'We're going back to Miami. We really want to see this and we couldn't get tickets....'"

They got in.

"We weren't really like policemen," says Lorraine Ramsdell, 44, a tour scheduler at the National Museum of Natural History. "Almost all of us love Star Trek, so we'd want as many people to see the exhibit as possible. Usually we'd send them to Walt [Walton Ferrell, the exhibit's operations manager]. Walt always had a few extra special exhibit passes in his pocket."

"If they were nice," she adds. "If they were unpleasant, they had less chance of getting in."

Volunteer Laurel Morse, a 31-year-old



program analyst at the Internal Revenue Service, remembers one young woman who, having waited in line for a long time, looked a little confused when asked for her pass. After digging around in her bag, the woman finally produced her German passport. "It seemed wiser to let her in than to try to explain what we were really looking for," Morse says.

If you were a devoted enough Trekkler, you did whatever it took to see the exhibit. Recalls volunteer Linda Wirth, a 48-year-old librarian, "I know one woman who came through and said, 'I came in from Atlanta. I'm staying with my sister. She thinks I came to see her but I really came to see this.'"

Attention, anyone with a Trekkler sister in Atlanta: now you know.

Some of Star Trek's more rapturous commentators have stressed the ideals of cooperation and equality that the series is said to have embodied. But when celebrities dropped by the Museum to take in the exhibit, equality sometimes had to take a back seat. Volunteer Karl Hester, a 35-year-old chef, recalls the day Gary Busey, star of

the movie *The Buddy Holly Story*, came through. "He was really rude to us," says Hester. "It was the very first day I worked there. He just passed by everybody and I asked him if he had a pass and he was like 'No' and just kept right on walking."

Still, sometimes special treatment of celebrities really is in order, if only to get them in and out as painlessly as possible so they don't hopelessly muck things up for the rest of us. In Washington, no one recognizes the wisdom of this better than the Secret Service. Realizing that the crowds at the Star Trek exhibit posed a good opportunity to practice the fine art of bodyguarding, the service started staging celebrity escort drills in the gallery. The volunteers would look up to see a phalanx of lockjawed G-men slicing through the crowd with grim dispatch. "Who is that? Who is that?" the volunteers would ask hopefully, only to be told, "Oh, that's just the Secret Service practicing getting someone famous through a crowd."

Volunteers could draw one of four duty stations: the waiting area, where two volunteers made sure that visitors queuing up for entry had passes; the entrance/exit, where one volunteer took passes and



Visitors were drawn by a wide-ranging collection: the spacecraft models used in the original *Trek* series and movies (below), as well as posters (above right), props, scripts, costumes (left), and even a pair of Spock's ears.



counted heads going in and another counted heads going out (these two coordinated their numbers so that no more than 250 people were in the exhibit at any one time); the "floater," a roving position; and the theater. Nobody wanted the theater. "That was the toughest area for traffic control," says Lee Falcon, a 30-year-old engineer. "The volunteer would have to keep the aisle between the theater and the exhibit open, but people wanted to sit there when the theater got full."

Working near the theater had other drawbacks. "You got tired of hearing the film over and over again," says Laurel Morse of the 20-minute documentary. The movie featured interviews with *Trek* stars such as Leonard Nimoy and William Shatner, as well as highlights from original episodes, including a segment from "The City on the Edge of Forever" in which guest star Joan Collins is hit by a truck. "On the other hand,"

jokes Morse, "it was pretty amusing to hear that screech of brakes a dozen times a day and know each time that Joan Collins was getting killed."

If they weren't aware of it before signing on, the volunteers quickly learned that there are two kinds of Star Trek fans in the world: those who wear costumes and those who do not. Most of the visitors to the Museum belonged to the second group, but now and then, much to the amusement of the volunteers, members of the first group would arrive. For volunteer Lorraine Ramsdell the best day was the day the Klingons came.

"They called in advance and asked for 20 passes," says Ramsdell. "So I stayed after my shift ended because I wanted to get a look at them." The





The night before the exhibit closed, the Museum hosted a reception to honor the volunteers, and many attended in full Trek attire. The highlight was a question-and-answer session with two actors from the original series: Mark Lenard (far left) and Majel Barrett, the widow of series creator Gene Roddenberry.

group leader rode the escalator to the second floor to make sure the passes were ready for them. "People parted in front of him like the Red Sea," Ramsdell recalls. "The Museum was crowded that day, but this man must have been six-foot-five. He was wearing this long flowing cape and not smiling. It was really a little intimidating. He was in character as well as in costume. I got my picture taken with him."

The Museum prohibited the volunteers from wearing costumes on duty, though Ramsdell says she wouldn't have worn one anyway. "But jewelry was allowed," she says, pointing to her "IDIC" earrings. "'IDIC' means 'infinite diversity from infinite combinations,'" she explains, fingering the small gold Trek keepsakes. And would any other fan recognize the symbol? "Oh yes," Ramsdell says, adding: "I have a necklace too."

Joe Rauscher's favorite costume story unfolds over the entire 11-month-long duration of the exhibit. He was working the first shift of the very first day, and that morning, he says, "a lady came in in a beautifully constructed 'Next Generation' Starfleet uniform." She wasn't affiliated with the show—Rauscher asked. Rather, she was simply a fellow fan ("A much bigger fan than I am," he adds) who'd made the uniform.

After they struck up a friendship, the woman not only ended up making Rauscher a costume of his own (again, he asked) but she became a volunteer herself. She was with him when he worked the last shift of the last day of the exhibit—something he arranged to do, he says, "for symmetry."

Rauscher planned to wear the costume to the closing-day party for the volunteers, but as the party date neared the costume maker was forced to use fabric glue and masking tape in places to meet the deadline. Rauscher began hoping for cool temperatures that would be more likely to leave the garment intact: "I didn't want to have to hide behind a plant all night," he says.

But the costume did hold together, and Rauscher (for whom the exhibit's closing was a "bittersweet experience, definitely") has no plans to retire it. "Any excuse to wear it," he says with feeling. "It's what it represents. It represents a better future."

Though the Star Trek exhibit turned out to be the most popular the Smithsonian has ever mounted, not every guest who visited really wanted to be there. "This one gentleman was from Sweden—it was funny because his wife, his kids were really into it but he wasn't," recounts Lorenzo Heard. "So he camped out next to me and he said, 'I know nothing about Star Trek. Is there anything that you like that I can talk to you about?' I said, 'Well, I'm into music.' So for the next three hours, while his wife and kids looked at the exhibit, the Swedish man talked to Heard about jazz musician Miles Davis—and only Miles Davis. "He was so pleased," says Heard. "He just couldn't believe it. You know, I wrote down the CDs I told him to pick up." Heard worked four hours that day, but it felt like all of 15 minutes. Says the volunteer: "I had a ball." ➔

All good things must come to an end: Star Trek finished its run at the Museum on January 31, and a new exhibit will be in its place by May.



If you're hooked on the history of flight...

Accept Guest Membership in The National Air & Space Museum

Your first benefit is the next issue of

AIR & SPACE

Smithsonian

Man's greatest adventure began when Orville Wright lifted off the ground for 12 seconds. Sixty-six years later, Neil Armstrong landed on the moon. But it wasn't until 1986 that a magazine devoted to flight was born.

NOW you can share the adventure in AIR & SPACE/Smithsonian.

SOAR with Voyager circumnavigating the globe nonstop.

SEE the giant Hindenburg materialize from the clouds and sail silently past you on her voyage to destruction at Lakehurst.

ORBIT Earth with Astronaut Sally K. Ride watching "smoke rise from fires that dotted the east coast of Africa, and moments later, ice floes jostling for position in the Antarctic."

Walk the bucking deck of an aircraft carrier at sea. Study pilots' UFO reports. Peddle across the English Channel in a human powered blimp.

You risk nothing

As a Guest Member of the National Air & Space Museum, accept the next issue of AIR & SPACE/Smithsonian on approval (cover price: \$3.50). Then subscribe, if you wish, at generous savings.

Take advantage of discounts on books, records, art and gifts from the Smithsonian Shops and the Smithsonian catalog. Attend free lectures. Enjoy reduced rates at the Museum's Imax films and Planetarium presentations. Your Membership Card guarantees a special member's welcome.

To accept this No-Risk offer and the savings that go with it, mail the coupon today.

**Accept the next issue of
AIR & SPACE/Smithsonian
as the Museum's guest.**



GUEST MEMBERSHIP APPLICATION

Please enroll me as a Guest Member of the National Air & Space Museum for two months and send me the next issue of AIR & SPACE/Smithsonian. My guest privileges also include discounts on books, records, art and gifts from the Smithsonian Shops and the Smithsonian catalog, free lectures and reduced rates at the Museum's Imax films and Planetarium presentations. If I choose to continue, I will pay only \$18 annually, and get five more bi-monthly issues for a total of six of AIR & SPACE/Smithsonian plus all other benefits above.

☐ Payment Enclosed.

☐ Bill me \$18

(Make check payable to Air & Space/Smithsonian.)

My name (please print)

Street

Apt

City

State

Zip

Gift recipient's name

Street

Apt

4A4R1

City

State

Zip

This guest membership is: ☐ For myself ☐ A gift ☐ Myself plus gift

Outside U.S., dues are \$24 payable in advance in U.S. funds. 85% dues designated for magazine subscription. Allow 4-6 weeks for delivery of first issue.

MAIL TO: AIR & SPACE/Smithsonian, P.O. Box 53261, Boulder, CO 80322-3261

HERE LIES QUENTIN ROOSEVELT

THE SEARCH FOR A FIELD IN FRANCE

BY WILLIAM JEANES

ILLUSTRATIONS BY KAREN BARNES/WOOD, RONSAVILLE, HARLIN



A gray tombstone on a gentle hillside in France marks the place where First Lieutenant Quentin Roosevelt was sent crashing to earth by a German machine gunner on a summer day in 1918. No signposts guide you to the solitary granite marker. No plaques tell the story of how he was left to rest alone where he fell. Or that as the child of Teddy Roosevelt, 26th president of the United States, he had once been the darling of a nation.

I first read about Quentin Roosevelt many years ago in Hermann Hagedorn's *The Roosevelt Family of Sagamore Hill*. Then I promptly forgot him. It wasn't until years later that I learned about Quentin's grave in another book, which described the site "...near the town of Chambray, just off the main road."

I knew that Americans who had died in World War I had either been brought home or ultimately re-interred in cemeteries for American servicemen, so the mention of a lone grave intrigued me. I began investigating further and learned that Chambray had never been behind German lines. Another source gave the grave's location as Cambrai, which had been behind enemy lines but in the wrong part of France. *A Guide to American Battle Fields in Europe*, a government publication I found in a used-book store, cleared up the mat-

ter. The town was Chamery, north of the Marne River. There were even directions to the grave: "At next village, Chamery, take first road to the left (impassable in wet weather) and go 800 yards to grave, which is 100 yards to left of road." I could not get the image of this remote, lonely burial place out of my mind.

So began an odyssey that took me through newspaper files, dozens of books, and letters written by Quentin, his friends, his subordinates, and his father. Ultimately it would take me to a peaceful slope at the edge of a wheat field in France.

On an overcast and muggy afternoon in June 1985, a friend and I went to Chamery and located the road mentioned in the battlefield guide. A woman watched us as we parked by the side of the road. In rudimentary French, I told her that we were searching for the grave of an American pilot.

"La," she said, pointing. "*Il est la.*" After further conversation I gathered that we were to go up the road to the "third woods." We set off, picking our way along a rocky path soaked by a recent rain.

Stepping off the 800 yards specified in the guidebook, we found ourselves in the middle of a wheat field. We headed left, stepping off another 100 yards through an 18-inch-high growth of wet, pale green wheat. After tramping all around



a large grove of hardwood trees for an hour, we called off the search. The wheat had soaked our trousers to the thigh, and the saturated ground had turned our shoes into gray balls of sticky mud.

"Well, we gave it hell," my friend said, "and there's always next year." I glumly agreed, feeling disappointed. Aggravating the disappointment, that winter I found an earlier edition of the battlefield guide, and this one contained photos of the grave and a memorial fountain. I had not known about the fountain.

Quentin Roosevelt was born in 1897, the fourth son and sixth child of Theodore Roosevelt, who was then assistant secretary of the Navy. Quentin was three when his father became president in 1901, and the youngest of the Roosevelt brood spent the next seven years growing up in the White House. His antics were widely reported, and the "White House baby" became the apple of the country's eye. In 1914, seven years after his father left the presidency, Quentin finished preparatory school at Groton. He entered Harvard the following year, just as the talons of war were reaching out from Europe to the United States.

Despite the nation's official neutrality, Americans were preparing for war, among them the sons of the hawkish Theodore Roosevelt: Theodore Jr., Kermit, Archie, and Quentin. Ted, the eldest, and Archie received commissions after attending the 1916 Army reserve summer camp at Plattsburg, New York. Kermit became an officer in the British army. (All three would be decorated.) Quentin went to Plattsburg following his freshman year at Harvard and was sent home with a certificate noting that "with more age and experience" he would make an "excellent" officer. He began his sophomore year at Harvard.

Like many of his contemporaries, Quentin was enchanted by aviation, romantically imagined as an arena where brave men met in glorious individual combat. He tried to join the Canadian Flying Corps in early 1917 but was thwarted by the threat of losing his U.S. citizenship and by poor eyesight. Soon after Congress declared war on Germany on April 6, Quentin joined the U.S. Army Signal Corps, the repository for the nation's feeble aviation effort. He and his cousin Hall Roosevelt memorized an eye chart and passed the phys-

ical. Quentin was assigned to flying school at Mineola, New York. The fourth cub of the "Big Bear" was in uniform.

Quentin and his brothers were following the wishes of their father, but they were also unquestionably caught up in the patriotic spirit of their time. Archie later said, "Oh, we looked at it as an exclusive war. We all knew how badly dad wanted to go so we went for him. He always told us to lead meant to serve." Quentin stated the case with equal clarity when he said, "It's rather up to us to practice what father preaches."

Sending others to fight was likely a delicate subject in the Roosevelt home. Theodore's father, a staunch Unionist, had

paid a substitute to serve in his place during the Civil War—a legal and generally accepted practice. But the substitute was killed, bringing sorrow to the elder Roosevelt and apparently a measure of shame to his son—the incident is not mentioned in Theodore Roosevelt's autobiography.

The sons of the wealthiest and most prominent families of the time attended Ivy League colleges, and it is instructive to note that Quentin was one of more than 11,000 Harvard men who served in World War I. Yale sent more than 14,000. To the educated young who stood to pay the price, World War I was a popular cause.

Following primary flight training at Mineola in a Curtiss JN-4 Jenny, Quentin sailed for Europe aboard the SS *Orduna* on July 23, 1917, as a member of the first group of American-trained aviators to reach France. By August, Quentin was assigned to the 3rd Aviation Instruction Center

at Issoudun, 150 miles south of Paris, for transition to the challenging French Nieuport.

The JN-4 was powered by the Curtiss OX-5, a V-8 engine that produced no untoward handling qualities. But the Nieuport's Le Rhône engine was a rotary, and its cylinders revolved like a huge flywheel, generating fierce torque forces on the airplane. As soon as Issoudun became operational, new pilots began training in *rouleurs*—French Morane-Saulnier monoplanes with clipped wings and no ailerons that the Americans called "Penguins." Stuart Elliott, another Roosevelt cousin, said the Penguins' 40-horsepower rotary engines enabled them to "...run over the ground like frightened jackrabbits, but they could not fly." The Penguins taught pilots to counter the Nieuport's tendency to tail-whip on take-



off and make abrupt left turns while taxiing.

Once out of the Penguins, pilots moved to comparatively placid dual-control Nieuports with large wings. From there, they graduated to a nimbler version, and finally to single-seat Nieuports with 80- and 120-hp Le Rhônes. In a letter home, Quentin wrote of the 80-hp version: "These little fast machines are delightful. You feel so at home in them, for there is just room in the cockpit for you and your controls, and not an inch more. And then they're so quick to act. It's not like piloting a great lumbering Curtis [*sic*] for you could do two loops in a Nieuport during the time it takes a Curtis to do one."

His opinions of the 110-hp Nieuport were initially negative: "I don't like it, from the point of view of personal comfort, for the motors are much harder to manage. You have the same plane—practically, with one hundred and twenty [actually 110] horsepower instead of eighty—and for some reason the one hundred and twenty motor is much harder to keep running. It's very easy to stall it when you're doing stunts and almost impossible to catch it again."

When Quentin arrived at Issoudun in August 1917, he was assigned to serve as the base transportation officer and soon took on a number of supply duties. One of only two U.S. officers who could speak French, he became more useful to the base commander as a problem solver than as a flier. His days were spent building a functioning base on the flat, muddy countryside. After hours he and Cord Myer, a boyhood friend, visited a nearby French base where Myer had arranged for them to fly.

In September, he and Myer were ordered to join up with the 1st Aero Squadron, but Quentin's superiors pointed out that he was too valuable in his current role and he was getting in plenty of flying at the French base. That—and the squadron's utter lack of airplanes—persuaded him and Myer to remain at Issoudun.

By December Quentin was in command of the Headquarters Detachment, overseeing 600 cadets and 40 officers. He performed so well that his efforts to have himself assigned to a combat squadron continued to meet with failure. In January he began acrobatic training, which he described as "wicked." In a letter he said: "They have one [maneuver] that they call a glissade that is the fastest thing I have ever run into in my life. You bank your machine up perpendicularly and then with your motor turning up at about three quarters speed, so as to keep the nose of the machine up, you slip perpendicularly down toward the ground. It's far faster than a straight nose dive, for you haven't got all the head resistance of the wings to hinder you. I got into it, and after coming down three hundred meters...got over onto my back, and...didn't have the slightest idea where I was or anything. I got

down to within about a hundred meters of the earth before I finally did get over to my right side again."

In March Quentin finished flight training and went to Cazaux, in Bordeaux, for gunnery school. After that, he was sent back to Issoudun to take charge of a training facility for formation flying. His students noted the constant, hovering presence of his Nieuport, which was colorfully decorated with a Rube Goldberg cartoon character named Dock Yack.

"Formation flying is the prettiest," Quentin wrote. "It looks fairly easy, too, but when you get up in the air trying to keep a hundred and twenty horsepower kite in its position in a V formation with planes on either side of you, you begin to hold different ideas on its easiness."

Through May and June, as U.S. squadrons began to reach the front, Quentin became increasingly frustrated at being kept from combat. When he learned that French squadron commanders could request American pilots, he went to Paris and pleaded for action. The attempt came so close to succeeding that he cabled his parents to say he and his friend Hamilton Coolidge were about to enter combat. But the plan fell through, and he and Coolidge remained at Issoudun.

On June 18, 1918, Quentin learned he would be assigned to the 95th "Kicking Mule" Aero Squadron and that Ham Coolidge would go to the 94th, later commanded by Eddie Rickenbacker, the U.S. ace of aces. These two squadrons, with the 27th and 147th, constituted the 1st Pursuit Group. "At last, almost eleven months after I left the states," he wrote home on June 18, "I'm doing what I came over here for, out at the front." He had 26 days to live.





Flying a Nieuport 28 in an action on July 10, Quentin became separated from his flight and, perhaps because of his poor eyesight, found himself on the tail of a German squadron. "They had been going absolutely straight," he wrote, "and I was very nearly in formation with them when the leader did a turn, and I saw to my horror that they had white tails with black crosses on them." He fired at the trailing airplane and saw it fall. An American artillery observer confirmed the kill.

On Bastille Day, July 14, Lieutenant John Hamilton led Quentin and seven other pilots on a mission departing from a field 20 miles south of Chateau-Thierry and heading over enemy lines. Hamilton and Lieutenant Paul N. Montague had engine trouble and turned back, leaving Lieutenant Ted Curtis in command. At 10,000 feet over German-held territory, the dwindling group encountered a flight of Fokkers, and a fierce dogfight ensued. Quentin did not return. Lieutenant Alexander McLanahan, another pilot with the 95th, and Curtis, who had made a forced landing, wrote differing accounts that exemplified an air combat axiom: in a dogfight, no one remembers exactly what happened. Later reports reveal that Quentin was shot twice in the head, and that his Nieuport went out of control and crashed in a field outside Chamery. He was 20 years old.

Quentin was buried the next day by German ground forces, who had identified him as Theodore Roosevelt's son. Captain James Gee of the 110th Infantry, at the time a prisoner of the Germans, described the scene: "In a hollow square

about the open grave were assembled approximately one thousand German soldiers, standing stiffly in regular lines. They were dressed in field gray uniforms, wore steel helmets, and carried rifles. Officers stood at attention before the ranks. Near the grave was the smashed plane, and beside it was a small group of officers, one of whom was speaking to the men."

On the morning of July 17, from his home in Oyster Bay, New York, Quentin's father issued a statement to the press: "Quentin's mother and I are very glad that he got to the front and had a chance to render some service to his country and to show the stuff that was in him before his fate befell him."

In a letter to writer Edith Wharton, Roosevelt was more open. "There is no use of my writing about Quentin; as I should break down if I tried," he wrote. "His death is heart breaking, but it would have been far worse if he had lived at the cost of the slightest failure to perform his duty."

An outpouring of tributes flooded Oyster Bay, sent by heads of state, friends, and ordinary citizens. Editorials appeared by the hundreds. The French navy named a destroyer the *Quentin Roosevelt*. Officials in Bismark, Pennsylvania, changed the name of their village to Quentin. A nation mourned its child.

Eddie Rickenbacker wrote in 1919, "Quentin Roosevelt's death was a sad blow to the whole group.... Everyone who met him for the first time expected him to have the airs and superciliousness of a spoiled boy. This notion was quickly

erased after the first glimpse one had of Quentin." Rickenbacker also offered a clue to Quentin's failure to return from his last flight: "He was reckless to such a degree that his commanding officers had to caution him repeatedly about his lack of caution. His bravery was so notorious that we all knew he would either achieve some great spectacular success or be killed in the attempt."

Private David Edwards, a crewman in the 95th, said of Quentin, "He had to wear glasses, but his eyesight was just as good as anybody's in the squadron. He was killed, I guess, because he was a little too brave." Edwards also said that the 95th's enlisted men called Quentin "The Go and Get 'Em Man" because of his eagerness to fly combat missions.

His cousin Stuart Elliott also commented on Quentin's eyesight: "[It] was not quite up to the minimum standard for a military flyer...it was common talk that he did not see as sharply as a war flyer should, and this may well have been a cause of his death in action."

The words of Rickenbacker and Edwards underscore another combat flying truth: no amount of instruction truly prepares a pilot for combat. Rickenbacker, as a squadron commander, knew that there was no substitute for experience, and he took pains to see that new pilots were seasoned on quiet missions before going on combat patrols. Quentin's combat career, however, began soon after his arrival at the front, and it lasted less than three weeks. Ham Coolidge, flying with Rickenbacker's squadron, became an ace with eight victories. He was killed in action just over three months later, on October 27.

In August, troops of the 32nd Division re-took Chamery, found Quentin's grave, and erected a more elaborate wooden fence around it. One of the 32nd's soldiers wrote that doughboys walked as far as five or six miles to visit the site. Between the world wars, the grave became something of a shrine to returning Americans.

The Roosevelts decided that Quentin should lie undisturbed in France, for whose freedom he had fought. In *Departing Glory*, Joseph Gardner wrote that when the ex-president learned that the War Department planned to bring home the American dead or re-inter them in military cemeteries, he lodged "a most respectful, but a most emphatic" protest. He and his wife, Edith, "agreed with the clergyman they had once known, who was fond of saying, 'Where the tree falls, there let it lie.' After the war, he and Mrs. Roosevelt planned to visit the gravesite in France, put up a small stone, and leave funds for local people to maintain the grave."

Quentin's sister Ethel, who had served with the YMCA in the war, remembered her father at their Maine house in the fall of 1918, staring out to sea and saying over and over, "Poor Quenty." Theodore Roosevelt died the following January. Still in deep mourning, Edith Roosevelt went to Chamery in February 1919 and visited her son's grave.

As my friend had foreseen during our futile search in the summer of 1985, there was a next year. Traveling alone this time, I drove to Chamery on May 31—Memorial Day in the United States—de-

termined to find Quentin Roosevelt's resting place. Thinking we had not gone far enough on our first try, I followed the overgrown path until it ended. I walked around the first wood that lay to the left of the road, and then the second. Looking back toward the village, I saw what I first took to be a box. Walking toward it across the plowed wheat field, I realized it was a tombstone.

Someone had tended the grave earlier in the spring, but the site had grown weedy. Two tiny flags, one the French tri-color and the other the Stars and Stripes, hung damply from their eight-inch staffs. On the granite marker, above a bronze laurel frond, were these words:

Here fell 1st Lt. Quentin Roosevelt
95th SQ 1ST PURSUIT GP
American Expeditionary Force
July 14, 1918

Having at last found the grave, I stood there wondering what to do. Unexpectedly, from a distant Mississippi childhood, came memories of families spending hot summer afternoons grooming the cemetery plots of departed relatives. I knelt in the damp grass and for ten minutes pulled grass and weeds from around the marker. Afterward the site looked better but still presented a lonely and lonesome aspect. I remember thinking of the thousands of lonelier graves in the valley of the Marne, graves that will remain unmarked and unknown forever.

I walked the short distance into Chamery and looked for the fountain. It stood on a side street near a large barn, from which a detachment of bored cows watched me. The fountain, in the form of a watering trough, was perhaps 12 feet long and four and a half feet high. Green moss hung from the bronze lion's-head spigot, which poured a delicate stream that ever so slightly rippled the surface of the water beneath it. The facing of the fountain bore the same information as the other stone, plus a quotation from an article Theodore Roosevelt had written for *Metropolitan* magazine after his son's death: "Only those are fit to live who are not afraid to die." I dipped my grass-stained hands in the fountain, shook them, and mopped my face, relieving the afternoon humidity with a cooler dampness.

A gunmetal sky threatened rain as I drove back to Paris in the late afternoon. The rolling countryside radiated a lush and cheerful green.

Four years later I learned that Quentin Roosevelt had not occupied the lonely site in Chamery for many years. His brother, Brigadier General Theodore Roosevelt Jr., had died of a heart attack on June 12, 1944, six days after the D-Day invasion of France. He was awarded the Medal of Honor for his leadership under fire at Utah Beach, and after the end of the war he was interred in the Normandy American Cemetery and Memorial at Saint-Laurent-sur-Mer. Later, Quentin was brought there to lie beside him.

At first I felt disappointed when I learned this. Then I realized that to me, it made little difference. ➔



Fantasy Islands

When Edward R. Armstrong made a study of great inventors, he discovered that most of them had died disappointed and poor. Such a realization might have discouraged less committed dreamers, but Armstrong was undeterred, and now his great vision for transoceanic flight was about to be realized.

In 1913, barely 10 years after the Wright *Flyer's* first hop, Armstrong had conceived a string of floating airports to sustain regular air service between America and Europe. Each seadrome would support a landing platform with services for aircraft and passengers. It was a grand and daring scheme.

For the next decade Armstrong perfected the design, dazzled financial backers and aviation experts, and secured commitments from major East Coast

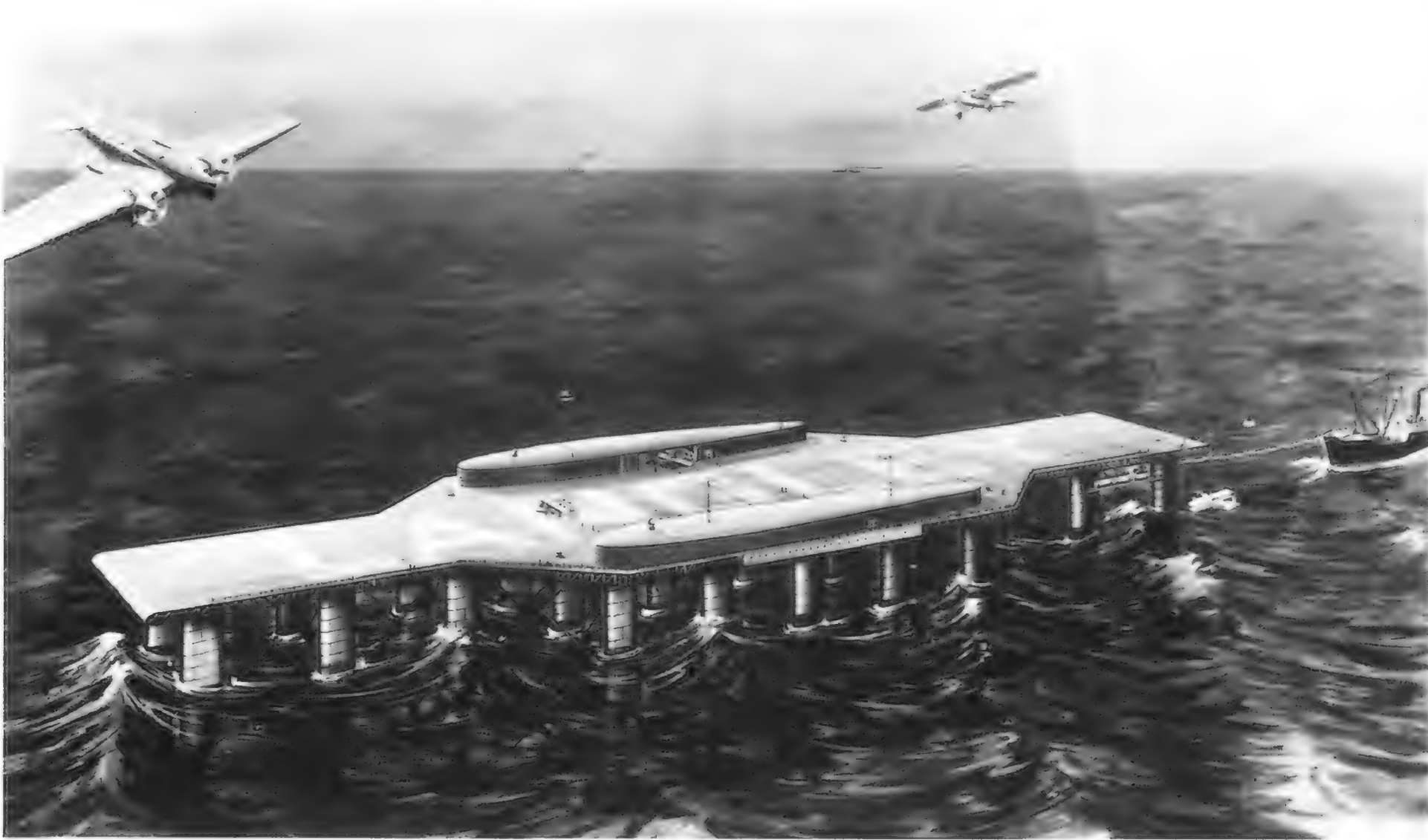
manufacturers. When his plan was ready, in the middle of Prohibition, he managed to buy a bottle of bourbon, and setting it on a shelf in his workroom, he vowed to open it the day the first seadrome began operations.

Armstrong had learned very early to set a goal and give it all he had. A sickly child said to have weighed only three pounds at birth, he had discovered "physical culture" at 12. By age 19 he was known as "The Strong Boy of Canada" and could, according to an Ontario newspaper, support 1,500 pounds on his chest, lift 150 pounds over his head with one hand, and break steel chains with his bare hands. After a brief stint as a professional wrestler, he began surveying pipelines for a U.S. oil company. All the while he studied at night and transformed

himself into an engineer, first doing freelance work on automobiles and aircraft, then research and development for the DuPont Company in Delaware. Now, with planning and determination, he intended to change the future of aviation.

While aircraft designers dreamed of more powerful engines and adventurers planned risky nonstop flights across the Atlantic, Armstrong proposed that shorter 400- to 600-mile hops would be safer and more practical for passengers and freight, as well as more profitable, since the reduced gas load would enable airplanes to carry up to five times more in payload weight.

The North Atlantic route had landfalls in Newfoundland and Iceland, but the region was always stormy. So Armstrong planned a southern route along the sunny



NASM (2)

Gulf Stream. Since commercial traffic required a high degree of safety and comfort, Armstrong had to ensure that his landing platforms would be especially stable.

The inventor's ingenuity was legendary. One writer who visited Armstrong's home in winter noted that hot water had been piped to the birdbath in the front yard. His design for the seadromes was a platform long enough for the largest airplanes (1,100 feet in 1931; 3,550 feet in 1943) and held 70 feet above the water by hollow iron cylinders that extended 120 feet below the surface. The seadrome would be built in sections, in relatively shallow water, by telescoping the columns during construction. Once completed, the platform would be towed to its location, its columns would be fully extended, and the structure would be anchored to the sea floor. Armstrong believed the seadrome should be secured at only one end so that it would always swing into the wind for landings and takeoffs. His anchorage system consisted of specially designed cables and mushroom-like anchors; he even designed a system to float the anchors to their destinations, as well as water brakes to keep them level and upright as they sank to the bottom.

To facilitate aircraft operations, the seadromes were to be equipped with powerful lights and radio beacons. Additional beacons would be located on buoys at intervals along the route. Service areas and repair shops for aircraft were to be built into each platform.

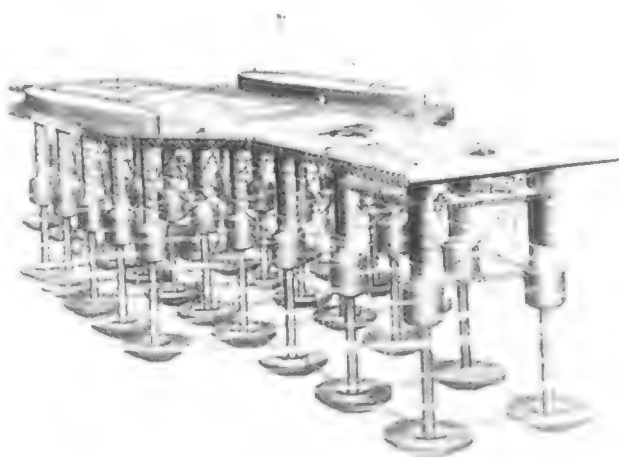
And so were a hotel and restaurant. Indeed, after considerable research, Armstrong declared that his offshore installations would not be subject to the laws of any single country, so plans were quickly developed to expand the basic amenities into luxurious resort-style accommodations, complete with gambling. The first of the seadromes, to be christened the *Langley* and positioned between New York and Bermuda, soon acquired the nickname "Havana in the Gulf Stream."

To test his idea, in 1929 Armstrong built two identically scaled models: a 35-foot version of the seadrome and a model of the oceanliner *Majestic*. The models were situated in the Chesapeake Bay and subjected to the equivalent of 60-foot swells. These simulations, recorded on film that would later be shown to President Franklin Roosevelt, showed that waves high enough to swamp the oceanliner barely rocked the seadrome.

Life must have seemed rewarding to Armstrong in those days. He had attracted the attention of the world and regularly made the front pages of the *New York Times*. The movie colony lionized him; Gloria Swanson threw a party in his

honor. Business executives from DuPont and General Motors formed a syndicate to provide financial backing. Prestigious manufacturing firms like General Electric, Sperry Gyroscope, and Radio Corporation of America, along with some of the best naval architects and engineers, were committed to the building of the seadromes. The Department of State, the Congress, and the president's staff were all engaged in trying to determine the seadromes' status under international law.

Many of the world's leading aviation experts announced their support. Louis Blériot was so enthusiastic he designed



an airplane especially for use with seadromes, and he later became the French representative for the Armstrong Seadrome Development Company. Igor Sikorsky was understandably interested since his amphibian aircraft was, in Armstrong's view, the natural front runner among aircraft for seadrome operation. Shortly after making his heroic 1927 Atlantic crossing, Charles Lindbergh spoke favorably of the plan when he met with President Calvin Coolidge.

The newspapers kept up a steady stream of optimistic reports on the scheme, announcing that construction would begin next year, or in August, or next month, or next week, or this week. At least twice, the papers claimed that construction had actually begun. And in 1930 the *New York Times* reported that several business conventions had reserved space on one of the seadromes.

But something always got in the way: Rising costs (\$1.5 million each at the start; \$12.5 million by 1943). Rejection of an application for a government loan. Uncertainty about seadrome neutrality in time of war. Aircraft engines ever more capable of long nonstop flights. And probably the natural reluctance of organizations and bureaucracies to spend huge sums of money on truly original ideas, especially during an economic downturn.

Armstrong's financial backers and manufacturers remained faithful to his vision of floating airports, but by the mid-1930s the inventor should have seen the

end coming. In 1934 the Federal Aviation Commission held hearings on the future of U.S. aviation, and Armstrong delivered an impassioned plea on behalf of seadromes. But he was dead last in the lineup of speakers, and worse yet, many of those who preceded him were former supporters. Now, however, Eddie Rickenbacker was promoting zeppelins for transoceanic service, while Lindbergh and Sikorsky had begun talking up nonstop flights.

Armstrong felt betrayed; when he finally got the floor, he complained: "I might say that almost without exception every man that has before this Commission questioned the utility of the seadrome has in the past given as his opinion that they would be very necessary and very advisable."

Despite his protestations, it was clear that both the government and the aviation community had lost interest in seadromes. The concept enjoyed a brief revival in 1943, when, under pressure of wartime needs, the Air Transport Command funded the construction of a trial section of a platform. But when Armstrong died in 1955, his grand passion was still unfulfilled.

Nonetheless, his idea has continued to surface. In 1970 a team of scientists and engineers proposed FLAIR, a Floating Airport for New York City, based on Armstrong's seadrome. In 1971, John Vickers, a World War I aviator who had worked on the seadrome model tested in the Chesapeake Bay, wrote an open letter implicitly directed to the U.S. Congress. In it he advocated the resurrection of Armstrong's design for floating airports (now "wetports") near large coastal cities and pointed out that at least 400 of the floating oil platforms then in use throughout the world were scaled-down copies of Armstrong's design. And in 1990 representatives from a host of aviation, naval, and business organizations suggested a floating airport for the city of San Diego. Their report did not mention Armstrong, but one of the designs they favored—a platform supported by columns—resembled his.

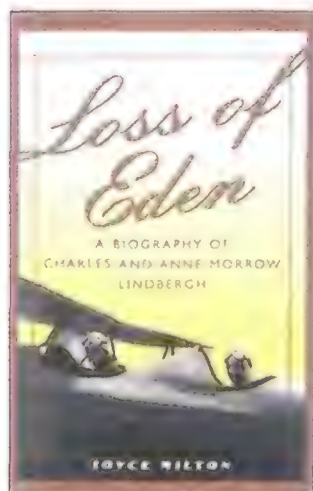
All in all, there's a largeness of spirit, a generosity of mind in grandiose visions like Armstrong's. When they succeed, they transform civilization. Even when they fail, their influence is often felt for decades, even centuries. Reducing fuel load and increasing payload is still a good idea, and with land for airports becoming scarcer and more expensive, floating airfields may catch on again. If Armstrong's heirs still have it, that bottle of bourbon would be well aged by now. As Armstrong learned early on, some great dreams aren't realized until long after the dreamer is gone.

—Joseph Bourque

A Not-So-Lucky Lindy

Loss of Eden: A Biography of Charles and Anne Morrow Lindbergh by Joyce Milton. HarperCollins, 1993. 520 pp., b&w photos, \$25.00 (hardbound).

There are no great surprises, just a constant flow of carefully crafted little ones, in this studiously researched joint biography of Charles and Anne Morrow Lindbergh. I was surprised to learn, for



example, that Lindy's epoch-making 1927 transatlantic flight from New York to Paris was probably much less of a gamble than is commonly believed. The new radial engine (the Wright J5C) that propelled the *Spirit of St. Louis*

had been designed to perform 8,000 hours or more without failure and was remarkably reliable.

Joyce Milton's chief preoccupation is not flying, however, but the kidnapping and murder of the Lindberghs' infant son, for which Bruno Hauptmann died in the electric chair in 1936. Yet here, considering the fact that the author is the first researcher to have gained access to the voluminous FBI files on the case, the biggest surprise is the lack of much that is new. She agrees with Anthony Scaduto's 1976 book that Hauptmann had accomplices—one of them probably a trusted Lindbergh family servant—but vehemently disagrees with Scaduto's theory that Hauptmann was a scapegoat.

We also learn of Anne's literary career and her white-knuckle fear of flying. On a European capital-hopping jaunt she and Charles made in 1933 in a red and black Lockheed Sirius, they became trapped above a fog bank and Lindy had to nurse the craft all the way from Amsterdam to Spain and back before finding a break in the gunk. Anne was so unnerved by the experience that she vowed to take the

next train to Paris. Eventually she relented and continued the tour, but she later put her foot down and refused to be her husband's co-pilot ever again.

The familiar if disheartening saga rolls on through Lindbergh's leadership in the isolationist America First movement, his flirtation with Nazism, and his war service. It turns out that Lindbergh made a genuine contribution during the second world war when he spent time in the Pacific demonstrating fuel saving techniques used by oldtime gypsy fliers; these techniques allowed him to surpass other pilots' fuel efficiency by a third.

Readers unfamiliar with Lindbergh's life will cringe as Milton alternately describes Lindbergh as "ludicrous," "a



AP/WIDEWORLD

loose cannon," and a man who "did not know who he was." All sadly true. One reads with a mixture of dismay and disgust of his "hatred of America," his admiration of the "magnificent spirit" of Nazi Germany, and his naive belief that Germany really intended to sell its latest 1,250-horsepower Daimler Benz engines to France—which, of course, the Nazis had no intention of doing. Lindbergh's misguided thinking reached its nadir when he accepted the Order of the German Eagle from Hermann Goering just a year before German panzers drove into Poland and put out the lights of Europe.

In the end, readers are left with the impression of a sky jock who might better have stuck with delivering the mail.

—William H. Honan is the chief cultural correspondent for the New York Times. His latest book is *Fire When Ready, Gridley!* Great Naval Stories from Manila Bay to Vietnam, to be published by St. Martin's Press this year.

One Zero Charlie: Adventures in Grass Roots Aviation by Laurence Gonzales. Simon & Schuster, 1992. 272 pp., \$20.00 (hardbound).

Almost 300,000 Americans hold private pilot licenses, and most of them operate out of little airports. This book, which takes its name from the designator code for Galt Airport in northern Illinois, is Laurence Gonzales' celebration of the life at the rural community airports that serve private pilots, people learning to fly, aerobatics contests, and chartered air taxis.

Gonzales brings a fresh voice to aviation writing, and some of the writing in this book is masterful. Attending an aerobatics meet, the author captures the essential craziness of a sport whose participants are its only spectators. By dint of a prodigious talent for hanging out with characters that are as distant from the mainstream as locomotive engineers,

Gonzales is able to create a living, breathing portrait of the driven folk who fill the ranks of "general aviation"—perhaps one of the most inept labels in all of Americana.

When he's on the airport ramp, observing in detail the rituals of the locals, Gonzales is at his best. When he groundloops off into the weeds searching

for the meaning of it all, the book occasionally loses its way. In addition, his seemingly restrained (but, in their total effect, gruesome) descriptions of fiery aircraft accidents leave the reader feeling a little uneasy, as if caught

in the act of attending the Indy 500 in order to see the cars crash in flames. Gonzales is gripped by a fatal attraction to the air even while he tells how his father, shot down over Germany in a B-17 and unable to bail out, survived the airplane's fall and eventually returned home after being reported presumed dead. Events such as these are surely evidence of cosmic forces at work, the book suggests, and when a gasoline leak threatens the author's own life, some dark shadow seems to loom up out of the prose.

For anyone seeking the heart-of-America aviation experience, though, the book is too rewarding in too many ways to be set aside for a single shortcoming. Gonzales serves as the medium by which we come in contact with the agonizing fears, the blinding frustrations, and the breathtaking moments of thrill in the achievement that marks the whole experience of taking an airplane into the air. Very few people have the talent and courage to do that.

—George C. Larson is the editor of *Air & Space*/Smithsonian.

TELEVISION

Arts & Entertainment Network's popular "Air Combat" returns with 13 new episodes on Wednesday nights starting May 12 at 8:00 p.m. EST (9:00 p.m. Pacific). In early May an episode of public television's "The New Explorers" will feature a recent mission of the shuttle *Endeavour*, with a focus on crew member Mae Jemison, the first African American woman astronaut to visit space. Check local listings for more information.

NORDICFLEX Gold UNLOCK YOUR POTENTIAL WITH NORDICFLEX GOLD.™

Breakthrough research proves you need the superior strength-training workout of NordicFlex Gold™ to look your best, feel your best and perform at your peak. Just three workouts a week let you:

- Lose three times more fat than with aerobics alone
- Replace fat with muscle to raise your metabolism
- Achieve increased cardiovascular fitness
- Build, shape and tone a firm, well-defined body
- Increase your energy level; reduce stress
- Build stronger bones; help prevent osteoporosis
- Achieve the poise and confidence that go with a body built for peak performance

GET RESULTS 70% FASTER.

Research proves the patented isokinetic resistance of NordicFlex Gold builds lean muscle 70% faster than rubber band systems like Soloflex* or free weights.

GET A FASTER WORKOUT.

With NordicFlex Gold you spend 40% less time between exercises than with Soloflex. Best of all, it costs 1/3 less than Soloflex.

Plus, the NordicFlex World Class™ Edition offers additional features to enhance your workout including the electronic performance monitor.

Best of all...it's from NordicTrack! 30-day in-home trial

FREE Video and Brochure, call 1-800-445-2360 Ext. 90KD3

or write: NordicTrack, Dept. 90KD3, 104 Peavine Road, Chaska, MN 55318

©1993 NordicTrack, Inc., A CML Company • All rights reserved.



HAND CARVED FROM SOLID MAHOGANY

World's Leading Makers of Fine Aerosculptures

Carved from mahogany by master craftsmen. Exquisitely hand painted markings and details. Museum quality • Stand included Size 16" to 22" • From \$99.50 Satisfaction Guaranteed

F-4U Corsair

OVER 200 MODELS

Pacific Aircraft

14255 North 79th Street, Suite 5
Scottsdale, Arizona 85260 • (602)991-1841

P-38 Lightning

CALL (800) 950-9944
FOR CATALOG AND ORDERS



It Was Like Searching for a Needle in a Haystack . . .



"SEARCH FOR
THE NEEDLE"
by John Young

750 Signed
and Numbered

Full Color
Lithograph
32" x 25"

\$145 plus S/H

VERY LOW
INVENTORY!



1993 marks the 50th Anniversary of the famous Yamamoto Mission, April 19, 1943. Each print, depicting the hazardous flight over 400 miles of open sea in search of Admiral Isoroku Yamamoto, is signed by the artist and personally autographed by the four lead pilots of the Yamamoto Mission: Commanding Officer John Mitchell, Douglas Canning, Del Goerke, and Jack Jacobsen.

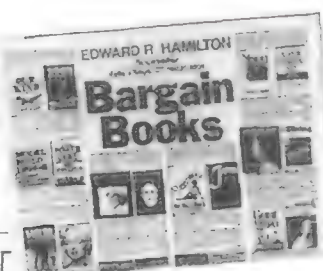
HERITAGE AVIATION ART brings you the best in aviation art by the world's most accomplished and well known aviation artists. We represent the finest in aviation art prints from *Aerodrome Press*, *The Greenwich Workshop*, *The Military Gallery*, and others.

TO ORDER OUR 56 PAGE FULL COLOR CATALOG send \$5, refundable with first purchase (U.S. Addresses) or \$10 (Outside U.S.). All purchases carefully packaged and guaranteed to arrive in perfect condition.

HERITAGE AVIATION ART
7201B Perimeter Rd. S. • Dept AS • Seattle, WA 98108 U.S.A.
CALL TOLL FREE 1-800-331-9044 • 206/767-4170
ORDER BY PHONE: Mon-Fri, 9 am - 6 pm



© 1993 Heritage Aviation Art



**FREE
CATALOG**
Huge Selection
Lowest Prices

Bargain Books

Overstocks, Remainders, Imports and Reprints from all major publishers. Books recently priced at \$20, \$30, \$40—now as low as \$1.95, \$2.95, \$3.95.

Choose from up to 8,000 titles monthly including 600-1,500 new arrivals.

Over 40 subject areas: Science and Aviation, Biography, Politics, Sports, Literature, Health, History, Nature and more, from yesterday's best-sellers to titles you never knew existed!

Fast Shipment, normally within 48 hours, and a moneyback guarantee.

Please send me your Free Catalog of Bargain Books.

Name _____

Address _____

City _____

State _____

Zip _____

HAMILTON

Box 15-294, Falls Village, CT 06031



J.A. Dubow
Mfg. Co.
A-2, AAF, 1942
Russet
Horsehide
\$500.00

J.A. Dubow Mfg. Co.
G-1, USN/USMC,
1944
Seal Brown
Goatskin
\$450.00



Professionals • Collectors • Enthusiasts

Scorn the mundane, discover **LOST WORLDS**. Most authentic **A-2, G-1, A-1, B-2** & classic horsehide motorcycle jackets in the world. Made in USA, unequalled craftsmanship. No compromises, fashion statements or hype. **Bought/Traded/Restored:** WWII through Vietnam flight jackets, insignia, memorabilia. Notable pieces sought for work-in-progress **US Flight Jackets 1927-68**.

Catalogue \$2.00 (refundable) mail to:



Dept. S, Box 972
Linden Hill, N.Y. 11354
Orders/Assistance:
(212) 923-3423/781-4026 (Fax)



REVIEWS & PREVIEWS

Bloody Shambles (Volume 1): The Drift to War to the Fall of Singapore by Christopher Shores and Brian Cull with Yasuho Izawa. Grub Street, 1992. 392 pp., b&w photos, \$49.95 (hardbound).

On January 29, 1942, a newly arrived Royal Air Force pilot made a textbook-perfect landing on Singapore Island as bombs exploded all around him. He taxied up to the slit trench in which the old hands were sheltering, slid back his canopy, and inquired: "I say, what is going on around here?"

Half a century later, historians investigating Japan's sweep through Asia in the winter of 1941-42 are still trying to answer that question. This book, by a noted aviation writer assisted by collaborators in Japan, the United States, and the British Commonwealth nations, is one of a handful to tell the story from both sides, often matching up the pilots who

COMPUTER SOFTWARE

Expert Astronomer by Expert Software division of Softsync (800 Douglas Rd., North Tower, Suite 355, Coral Gables, FL 33134). Available for Macintosh and DOS (but not Windows). Suggested retail price, \$49.95.

What's that bright object just to the south of celestial noon? Fire up this software, which contains over 9,000 celestial objects in its database, and within moments you'll know. The easiest single use I've found for the Macintosh version of "Expert Astronomer" is its ability to depict the night sky as it is right now. Select a window depicting the heavens, click on a button marked "now" in the Time box, and after retrieving the date and time from the computer's calendar, *voilà*—a complete sky with all the planets in place. Tools allow the user to manipulate the display as needed; the handiest tool is a cursor with a question mark. Use it to click on an object and information pops up in a window.

Even more entertaining are a time lapse sequence of eclipses—I ran it during a recent lunar eclipse in Washington, and it was true to the real thing—and views of the sky as seen from other planets. You can also track objects on the screen by invoking a command that plots movements. At this price, you'll be junking all your sky maps within a week.

—George C. Larson

flew in opposing cockpits.

Expect surprises. "British" pilots in Asia were more often Australians, New Zealanders, South Africans, Canadians—even Americans. Saburo Sakai did not shoot down the B-17 flown by Colin Kelly, the first U.S. war hero, and Lieutenant Kelly did not sink the battleship *Hiruna*. The much-maligned Brewster Buffalo was in fact liked by some of the men who flew it. Victories claimed by the Flying Tigers of Burma may actually have been made by the RAF.

Bloody Shambles is rich in anecdote and well salted with photographs, of which the most affecting are squadron portraits of RAF pilots with terribly young faces. In the tradition of British aviation books, the narrative is exhaustively detailed—so much so, in fact, that readers unfamiliar with these campaigns may have trouble following it.

—Daniel Ford is the author of *Flying Tigers*; Claire Chennault and the American Volunteer Group (Smithsonian Institution Press, 1992).

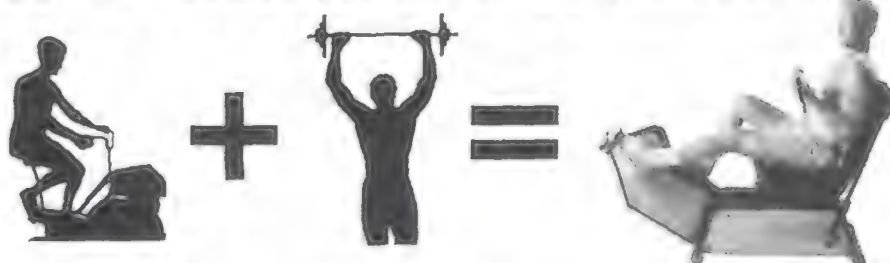
Aces of the Pacific by Dynamix Inc. (PO Box 485, Coarsegold, CA 93614). Available for the IBM PC and compatibles. Suggested retail price, \$79.95.

Veteran fighter pilots always recommend using the advantages of your aircraft and not allowing the enemy to bring you down to his level. That this advice proves useful in "Aces of the Pacific" is a testament to the quality of this computer-based flight simulator, which allows users to re-create the action of World War II naval aviation. Users can fly either U.S. or Japanese aircraft and choose from a selection of a dozen types on each side. True to history, most of the U.S. aircraft take damage well and have firepower and diving capabilities superior to those of their Japanese counterparts. The Zeros generally excel in a pure "turning war."

If you want to try your stuff against a Japanese ace, you can pick Saburo Sakai or any other of the dozen aces available as an adversary. And if it would make you feel better to have U.S. Marine ace Joe Foss as your wingman, he's available too. The software also offers a variety of options for customizing the realism of the simulation, including gun jams, engine burnouts, and sun blind spots. A joystick is recommended for the flying—it's up to you to decide whether to wear a flight jacket.

—Bernard Dy reviews computer software from his home in Houston, Texas.

Only One Machine Equals a Balanced Workout!



NordicTrack's **Total-Body Fitness System™**



Call for a 30-day in-home trial.

Today, experts recommend *both* aerobic exercise and strength training. Here's why: studies show that **those over age 30 can lose at least a half-pound of muscle each year.** Now NordicTrack's Total-Body Fitness System™ brings you a **balanced workout on one compact machine!** Its recumbent bike gives you an energizing aerobic workout. And its upper-body exerciser tones your muscles and builds your strength. Get this health-club workout in your home—in just minutes a day!

Best of all, it's from **NordicTrack**

Call today for a **FREE Video and Brochure!**

1-800-892-2183 Ext. 3Q5D3

or write: NordicTrack, Dept. 3Q5D3, 104 Peavey Road, Canby, MN 55005

☐ Please send me a free brochure

☐ Also a free VHS videotape

Name _____

Street _____

City _____

Phone (____) _____

©1993 NordicTrack, Inc. A CMI Company • All rights reserved.

HANDCRAFTED AVIATION DISPLAY MODELS

• Over 500 Aviation Display Models Available • Custom Model Building Services Available

SHOWCASE MODEL CO.

P.O. Box 470, Dept. A/S-93-04

State College, PA 16804-0470

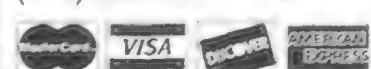
Hours: M-F 9:30am - 7:00pm

Sat: 9:30am - 4:00pm

(800) 441-9524 -Orders

(814) 238-8571 - Catalogs

(814) 238-8572 - FAX



WORLD'S LARGEST MAKER OF AEROSPACE REPLICAS



Lockheed/USN WV-2
"Willie Victor" (EC-121M)
@ \$149.95

BUILD C-D MODELS!

Real collector's choice items! Since 1978 I am still making my world-famous authentic historic C-D Master Flying Model airplane plans available to you. 1900-1950 and 1952 to 1974 size 10 1/2" to 20" scale, each full size for \$9. C-D, P-F, rubber, electric, G-12, static, 1400 plans! Ask and I'll send you many of the models at no cost. In Air Force, Navy & D of C area museums. Illustrated price \$1.00 bill, or \$2.00 with picture, booklet, Foreign Express Can. Mail by air \$3.00. "Same day service." 215-561-2500. We have no dealers. ©1993 C.D. Models. All rights reserved. **CLEVELAND MODEL & SUPPLY CO.** 9800AS Detroit, Cleveland, OH 44102

WANTED

PILOTS, ENGINEERS & A&P's

Nationwide & Overseas Positions

Call (800) 543-5201 or (201) 794-3820

CREDITS

up 1.9 hours of instruction in the Mudry Cap 10B and now hardly gets queasy at all in inverted flight.

Is Something Out There? Frank Kuznik is a frequent contributor to *Air & Space/Smithsonian*. His most recent piece, "The Einstein Test," appeared in the December 1992/January 1993 issue.

Further reading: *Planets Beyond: Discovering the Outer Solar System*, Mark Littmann, John Wiley & Sons, 1988.

Pictures from St. Petersburg. Slava Olshevski is a businessman in St. Petersburg, Russia. He visits the United States frequently and has had a lifelong interest in aeronautics.

Further reading: *Gatchina Days*, Alexander Riaboff, Smithsonian Institution Press, 1986.

The Flight Attendants. Diane Tedeschi is an associate editor at *Air & Space/Smithsonian*.

Here Lies Quentin Roosevelt. William Jeanes is editor-in-chief of *Car & Driver* magazine.

Fantasy Islands. Joseph Bourque is a pilot and freelance writer whose work has appeared in *American Heritage*, *Modern Maturity*, and *Newsweek*.

CALENDAR

In the Museum. The oil paintings by Chesley Bonestell used in "The Best Laid Plans" are: "Assembly of Moon Expedition in Earth Orbit," 1952; "Landing on the Moon," 1952; "Baby Space Station," 1953. Paintings courtesy of the Frederick I. Ordway III collection, U.S. Space and Rocket Center, Huntsville, Alabama.

The Condor and Me. Louis Arata spent only ten minutes in the Curtiss Condor 18 but the experience stayed with him. Almost forty years later, he earned a private pilot's license and now flies a Piper Cherokee not too far from his old neighborhood.

Potty Training. Beth Dickey, a reporter for Reuters News Service, has stopped worrying about whether the tissue goes over or under the roll.

Race to the Sun's Edge. A contributing editor of *Air & Space/Smithsonian*, Gerrit L. Verschuur wrote "This Target Earth" for the October/November 1991 issue.

Further reading: "The Local Interstellar Medium," Don Cox and Ron Reynolds, *Annual Reviews of Astronomy and Astrophysics*, 1987.

Now Playing at an Airport Near You. Phil Scott, who lives in Manhattan, racked

May 15
Fly-In/Drive-In Pancake Breakfast. Sponsored by the Prairie Aviation Museum and FBO Clark Aviation. Clark Aviation Hangar, Bloomington-Normal Airport, Bloomington, IL, (309) 663-7632.

Spring Fly Market. Sponsored by Northeast Texas Chapter 834 of the Experimental Aircraft Association. Franklin County Airport, Mount Vernon, TX, (903) 856-5992.

May 15-16
Kalamazoo County Parks' Kitefest. River Oaks Park, Kalamazoo, MI, (616) 383-8778.

May 23
Experimental Aircraft Association Chapter 15 Annual Fly-In/Drive-In Pancake Breakfast. Lewis University Airport, Romeoville, IL, (312) 735-1353.

April 2-4
Fifth Annual Ozark UFO Conference. Speakers, audiovisual presentations. Inn of the Ozarks, Eureka Springs, AR, (501) 354-2558.

April 28-May 1
26th Annual National Congress on Aviation & Space Education. Field trips, exhibits. Disney's Contemporary Resort and Convention Center, Lake Buena Vista, FL, (301) 898-0402.

May 1-2
Museum Showcase and Aircraft Walkabout. Lone Star Flight Museum, Galveston Municipal Airport, Scholes Field, Galveston, TX, (409) 740-7722.

May 8
Reno Airline Collectibles Show. Door prizes, vendors. Reno Airport Plaza Hotel, Reno, NV, (209) 275-8353.

Now you can do something about the weather

Low as \$149

Our new Home Weather Station helps you plan your day, safeguard your family and property by alerting you to local weather conditions that often vary from distant forecasts.

Alerts you when wind chill threatens frostbite. Tells you to secure outside belongings against unexpected gusts, protect plants against dangerous heat or cold, and much more. Designed to far outlast all others, the ULTIMETER II gives you over 20 most-wanted features including:



Actual size: 6 1/2" x 2 1/4"

- Wind Speed and Direction
- Temperature
- Chill factor
- Alarms
- Highs / lows / times / dates
- Metric / English
- Quick

Mount (no tools) masthead mounting • Fast, easy "Point & Plug" direction calibration (pat. pending) • 40 ft. cord • Optional self-emptying rain gauge • 30-day money back guarantee • One-year warranty

Home Weather Station only \$179
As above, without wind direction sensor \$149

Del. in US, add \$8.25 shipping & insurance. NJ res. add 6% tax
VISA/MC phone orders: 800-USA-PEET (872-7338).
Or send check, m.o. or credit card no. and exp. date to:

PEET BROS. COMPANY 601-304A Woodland Rd.,
W. Allenhurst NJ 07711

Free Brochure Our 17th Year

SMITHSONIAN VISITORS

The Associates' Court,

a restaurant in the National Museum of Natural History, is open from 11 a.m. to 3 p.m. daily.

Weekdays: luncheon buffet available continuously from 11 a.m. to 3 p.m.

Weekends: brunch service from 11 a.m. to 1 p.m. followed by luncheon service to 3 p.m.

Air and Space Associates presenting a current membership card will receive a 10 percent discount on meals for themselves, family members and guests.

SCALE MODEL AIRLINERS

HUNDREDS OF DIFFERENT LIVERY AND BODY STYLE COMBINATIONS
ASSEMBLED & KIT FORM IN MANY SCALES




AT THE TRAIN SHOP CATALOG: \$2.00
23 W. 45TH ST. NEW YORK, NY 10036


"The Satellite Sky" Update/35

These regular updates to "The Satellite Sky" chart will enable readers to keep their charts up to date. Additions can be clipped and affixed to the chart at the appropriate altitude.


New launches

90 to 300 MILES


 **Cosmos 2225**
12-22-92 TT


 **Cosmos 2231**
1-18-93 PL

 **MAK-2**
11-20-92 MIR

 **Soyuz TM-16**
1-24-93 TT


300 to 630 MILES


 **Cosmos 2227**
12-25-92 TT


 **Cosmos 2228**
12-25-92 PL

 **Cosmos 2230**
1-12-93 PL

 **Cosmos 2233**
2-9-93 PL


 **Keyhole 11-9**
11-28-92 VAFB

 **OXP-1**
2-9-93 B-52


 **SCD-1**
2-9-93 B-52


DATA SOURCES: NASA

630 to 1,250 MILES


 **Cosmo 2226**
12-22-92 PL

6,200 to 13,700 MILES

 **GPS-17**
12-18-92 CAC

 **GPS-18**
2-3-93 CAC

21,750 to 22,370 MILES

 **Cosmos 2224**
12-17-92 TT

 **TDRSS**
1-13-93 KSC

Launched but not in orbit

90 to 300 MILES

Cosmos 2229 CIS research	12-29-92	down 1-10-93
STS-54 U.S. research	1-13-93	down 1-19-93

Inoperative but still in orbit

300 to 630 MILES

Cosmos 1842
Cosmos 2058

630 to 1,250 MILES

Cosmos 1803

Deletions

90 to 300 MILES

Cosmos 2164
down 12-12-92

Cosmos 2220
down 1-18-93

Progress M-15
down 2-7-93

Soyuz TM-15
down 2-1-93

FORECAST

In the Wings...

Hot Flashes. For 25 years, detectors in space have recorded mysterious bursts of gamma rays coming from all directions in the sky. Astronomers are trying to pinpoint where in the universe they're coming from and what in the world is causing them.

Testing Jets by the Numbers. The life and times of a military test pilot have changed since Tom Wolfe glamorized the

profession in *The Right Stuff*, but pulling this duty can still be the ticket to space.

Big Guns. As launch systems, light gas guns and ram accelerators pack a hell of a punch.

Sunken Treasures. For underwater photographer David Doubilet, airplanes at the bottom of the ocean have all the mystery and romance of any shipwreck.

KITES

FREE COLOR CATALOG
Choose from over 200 exciting kites.
• Many unusual & innovative designs.
Call or write for your catalog today!
Into The Wind • (800) 541-0314
1408-K Pearl St., Boulder, CO 80302



THE SPACE SHUTTLE IN A SPECIAL BIRTHDAY CELEBRATION

In honor of the space shuttle's 10th birthday (it first flew in April 1981), *Air & Space/Smithsonian* asked a number of artists to decorate their own shuttles. Forty of the resulting visions—whimsical as well as serious—are featured on this colorful 22- by 33-inch poster. On the back, read about the shuttle's technological family tree. Printed on durable, high-quality paper, this special version of the poster will come to you rolled, not folded!

TO ORDER: Send \$9.95 UPS postage paid to Space Shuttle, *Air & Space/Smithsonian*, 370 L'Enfant Promenade, 10th Floor, Washington, DC 20024

Celebrate July 4th & All Events CARBIDE CANNON

BIG BANG! \$109.⁹⁵

Mammoth Cannons shoot with terrific BANG! Have a bang-up time at special events. Uses powdered carbide ammo. Hundreds of shots for few cents. All metal construction with large, rugged cast-iron wheels. Machined brass mechanism for easy loading and firing. Authentic turn-of-century design. Hand-come down when not in use. Made in USA to last a lifetime. Available in 3 sizes: 9" cannon, \$49.95 postpaid; 17" cannon, \$89.95 postpaid; 25" cannon (shown here) with rapid firing and automatic loading, \$109.95 postpaid. The larger the cannon the louder the bang! Carbide ammo, about 100 shots, \$5.00; 3 packs for \$12.00. Send check, money order or call. Visa, MasterCard accepted by mail or phone (215) 866-0777. Give card number & expiration. Money-back guarantee.

The Conestoga Co., Inc., Dept. A PO Box 405, Bethlehem, PA 18016

SEND FOR FREE CATALOG!

Counted Cross Stitch **PLANES** Catalog \$3.00



P-51 Mustang Kit \$27.00 + \$4.00 S&H

A & L Designs dept. (S) 201 East Tabor Rd., Philadelphia, PA 19120
(215) 325-7321



JOHN HEINLY

Hangar 9

When military officials surveyed an 873-acre stretch of scrub south of San Antonio in late 1917, they saw a typical south Texas landscape: prickly pear cacti, mesquite trees, and cattle. The cattle looked back and saw lunch.

The cloth coverings on the wings of the Curtiss JN-4 biplanes, or Jennies, that the military had brought to the new air base had been treated with banana oil so that the fabric could be stretched tightly. "If they left the planes alone," explains Fernando Cortez, curator of the Edward H. White II Memorial Museum at San Antonio's Brooks Air Force Base, "the cows ate the wings."

To protect its aircraft from the cows—not to mention windstorms, dust, and the odd rattlesnake—the Army built 16 wooden hangars at Brooks in early 1918. Today, one remains: Hangar 9, site of the White museum and the U.S. Air Force's only surviving World War I hangar.

Except for the orange windsock atop one end of the building, Hangar 9 looks more like an aging high school gym than a piece of military history. It doesn't even *sound* like an air base: the last official flight left Brooks more than 30 years ago. Today, the base is home to the School of Aerospace Medicine and the research groups that probe the boundaries of human performance in air and space. Inside, though, the hangar presents an eclectic mix of seat-of-the-pants aviation pioneering and Space Age scientific research.

A beautifully restored Jenny, for example, co-exists with a contraption called the Rotational Flight Simulator—a three-ton steel cocoon in which John Glenn and fellow astronauts prepared for spaceflight. Wool uniforms and leather cavalry boots worn by the earliest military aviators mingle with the pressure suits of Project Apollo.

For all its scope, though, the Hangar 9 collection seems intimate and personal. In large part, that's due to Cortez, a chatty aviation buff and accomplished scrounger. Cortez pokes through scrap yards and junk stores, occasionally excavating

aviation treasures. He found a carburetor for the museum's Jenny at a nearby propeller shop. And in the loft of a crowded warehouse he uncovered—one layer at a time—two B-17 ball turrets, thousands of World War II-surplus parachute harnesses (an undergarment factory bought the silks shortly after the

Edward H. White II Memorial Museum, 684 SPT-MU, Brooks Air Force Base, TX 78235. Phone (210) 536-2203. Open 8 a.m. to 4 p.m., Monday through Friday, except holidays. Free admission.

war), and a case of aviation goggles worn by Women Airforce Service Pilots during World War II. Cortez returned the goggles to their original owners at a WASP reunion last year.

Naturally, the museum contains plenty of reminders of the famous individuals who once strolled through Hangar 9, including its namesake, Edward White II, the first American to walk in space and a victim of the Apollo 1 launch pad fire. White played in the hangars when his father, who eventually became an Air Force major general, was stationed at Brooks.

Most of Brooks' famous alumni were stationed there during the 1920s, when the base was site of the Army Air Corps' primary flight training school. Among the recruits was Charles Lindbergh, who reported for duty in his own war-surplus Jenny. Claire Chennault, who later commanded the Flying Tigers, also passed through Hangar 9, serving as one of the military's top flight instructors.

One of Chennault's pilots in China, David Lee "Tex" Hill, donated much of his war memorabilia to the museum: khaki bush jacket, Chinese currency, cloth "blood chits" that promised to reward the safe return of downed American pilots, and a samurai sword recovered from the wreckage of a Japanese aircraft that he out-dueled.

Many of the men who saw duty at

Brooks lived less thrilling lives, of course. But their work helped make aviation and spaceflight safer. They were guinea pigs for the scientists and engineers who designed new flying machines, spacesuits, and other equipment. Their story is also told at Hangar 9, in the form of devices that bear an unnerving resemblance to medieval implements of torture.

There's the Ocker Chair, for example. Subjects were strapped into the metal chair, then spun wildly about. An instrument located inside a small box told them which way they were turning, often contradicting their jostled sense of balance. The device convinced aviators that they couldn't always rely on their senses—that better instruments were essential additions to the cockpit.

Inevitably, though, your eyes and heart wander back toward the Jenny. Painted in World War I colors, it's equipped with an OX-5 water-cooled engine, which powered early versions of the airplane. Strong vibrations frequently jiggled hoses loose, so the engine often overheated. The engine is also heavy, so the aircraft flipped over easily on landing.

Wrestling the Jenny into the air presented its own problems, particularly as early airfields were simply patches of grass and dirt. "When you taxied out, if you ran over any cactus it punctured the thin rubber tires," Cortez says. "Or you might get too close to a rattlesnake and it would strike at a tire and ruin your whole day. And if you couldn't get off the ground, you had mesquite trees waiting at the end of the field."

Just in case problems developed in the air—like wheels falling off, which happened frequently—pilots had special landing instructions. "A lot of student pilots were taught to find the largest tree in a field and plow into it," Cortez explains. "Or they might land between two trees that were close together and let them rip off the wings. That way the trees absorbed most of the impact." And created a nice snack for some appreciative Texas cattle.

—Damond Benningfield

N O P L A C E L I K E H O M E



Smithsonian



PLANET EARTH

A COMMEMORATIVE EARTH DAY POSTER FROM THE APRIL 1990 SMITHSONIAN

The Poster measures 21 $\frac{3}{4}$ " x 28 $\frac{3}{4}$ "
Printed on Recycled Paper
Allow 4 to 6 weeks for delivery

Send \$5.00 with address to:
Smithsonian Magazine, P.O. Box 23624,
Washington, D.C. 20026-0624

A CELEBRATION OF SOLAR SYSTEM EXPLORATION

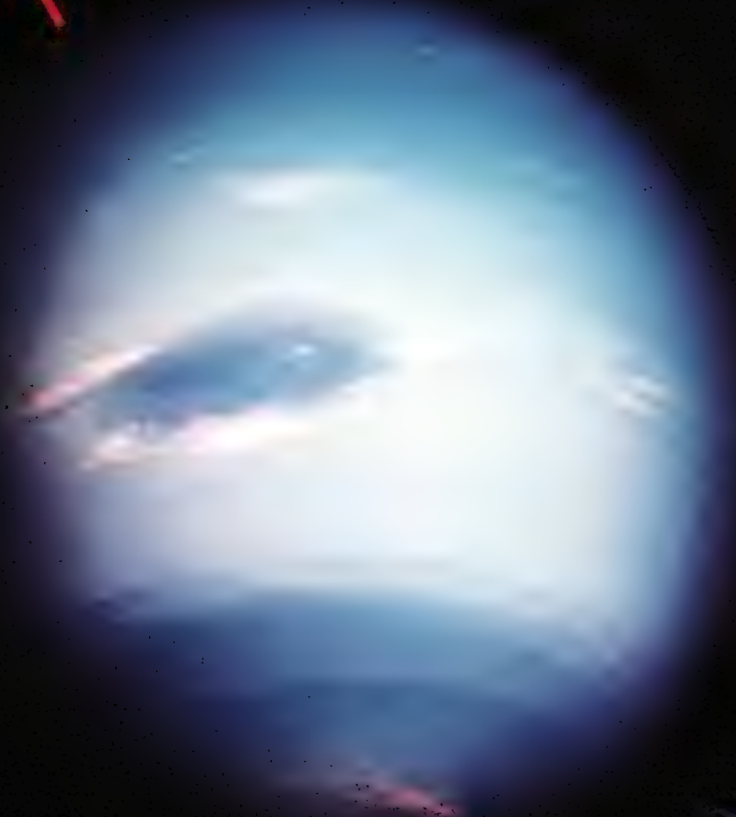
AIR&SPACE

Smithsonian

A supplement to the April/May 1993 issue
of *Air&Space/Smithsonian*
©1993 Smithsonian Institution

Pluto

Pluto is the only planet in the solar system never visited by a spacecraft from Earth. That could change: NASA is considering a low-cost Pluto mission by the end of the century. Because its orbit is so eccentric, Pluto will actually be closer than Neptune to the sun until 1999.



Neptune



Voyager 2

B E Y O N D



Halley's Comet

An Old Faithful of the comet world, Halley's makes a swing through the solar system every 76 years. During its 1986 visit, Halley's was visited by no fewer than six spacecraft, including two Soviet Vegas, which dropped probes off at Venus on the way. The nearest approach, made by the European Space Agency's Giotto, came within 370 miles of the nucleus (left). The International Cometary Explorer visited Halley's after a 1985 encounter with the comet Giacobini-Zinner.



Vega 1



Vega 2

Mariner 2



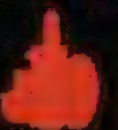
Venera 14



Venera 4



Zond 1



Venera 16

Venera 12

ONLINE

Gaspra

Just one of the thousands of small rocky bodies in the asteroid belt, which for the most part lies between Mars and Jupiter, Gaspra was visited by Galileo in 1991. It was just one of the waypoints on the probe's circuitous journey to Jupiter, which it will reach in 1995.

ICE



Giotto



Sakigake



Suisei



Galileo



Mars 3



Mars 2



Mars 1



Mars 4



Mars 5



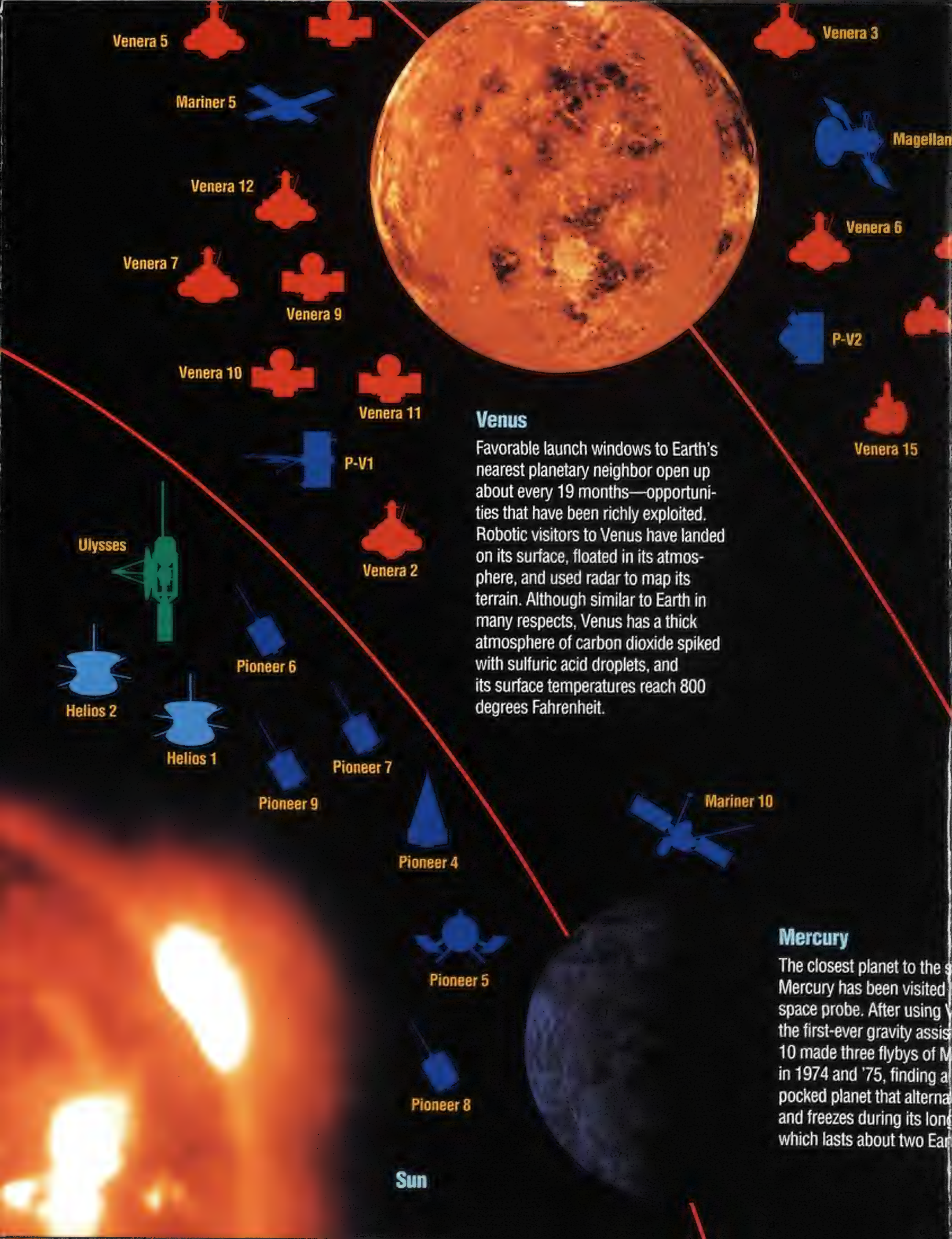
ART H

Saturn

Saturn is best known as the ringed planet, although Jupiter, Neptune, and Uranus have ring systems as well. But Saturn's is the most spectacular and complex, consisting of thousands of rings and ringlets, along with mysterious "spokes" that run through the structures and small "shepherd" moons that help organize the material.



Voyager 1



Venera 5

Venera 3

Mariner 5

Magellan

Venera 12

Venera 6

Venera 7

Venera 9

P-V2

Venera 10

Venera 11

Venera 15

P-V1

Venus

Favorable launch windows to Earth's nearest planetary neighbor open up about every 19 months—opportunities that have been richly exploited. Robotic visitors to Venus have landed on its surface, floated in its atmosphere, and used radar to map its terrain. Although similar to Earth in many respects, Venus has a thick atmosphere of carbon dioxide spiked with sulfuric acid droplets, and its surface temperatures reach 800 degrees Fahrenheit.

Venera 2

Ulysses

Pioneer 6

Helios 2

Helios 1

Pioneer 7

Pioneer 9

Pioneer 4

Mariner 10

Pioneer 5

Pioneer 8

Mercury

The closest planet to the Sun, Mercury has been visited by only one space probe. After using Venus for the first-ever gravity assist, Mariner 10 made three flybys of Mercury in 1974 and '75, finding a pockmarked planet that alternates between scorching and freezing during its long day, which lasts about two Earth days.

Sun

Mars Observer

Zond 2

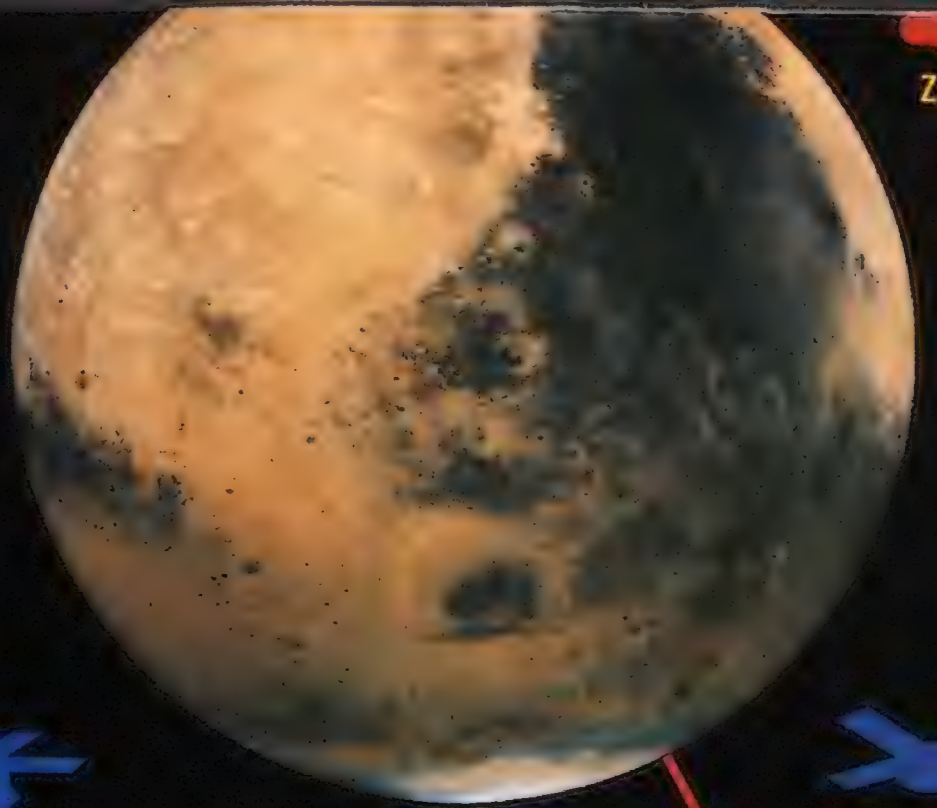
Mars 5



Mars 6

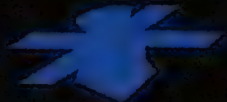


Mars 7

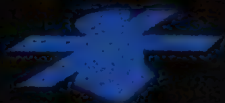


Venera 8

Venera 1



Viking 2



Viking 1



Phobos 2

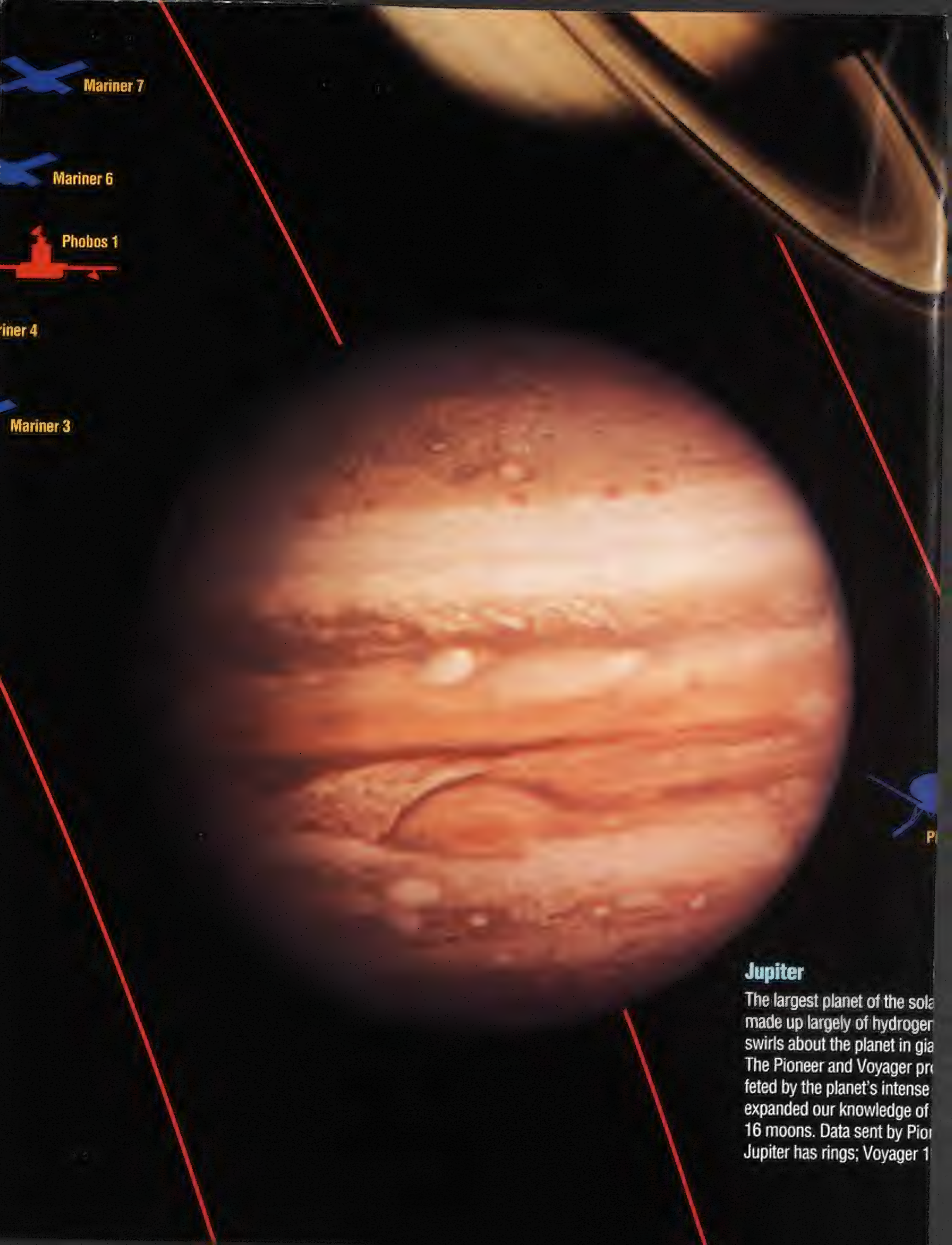
Mars

Long the subject of fanciful speculation, Mars turned out to be less than hospitable by Earth standards, with cold temperatures and a thin carbon dioxide atmosphere. Still, there is evidence that water once flowed on its surface, and future expeditions may reveal why it disappeared.



Earth

in,
y only one
enus for
Mariner
rcury
rater-
ly bakes
day,
i months.



Mariner 7

Mariner 6

Phobos 1

Mariner 4

Mariner 3

Jupiter

The largest planet of the solar system is made up largely of hydrogen and helium. Swirling about the planet in giant storms are clouds of ammonia, water, and methane. The Pioneer and Voyager probes, launched by the planet's intense magnetic field, expanded our knowledge of Jupiter. It has 16 moons. Data sent by Pioneer 10 and 11 showed Jupiter has rings; Voyager 1

Neptune was the last planet
Voyager 2 encountered before head-
ing off for the limits of the solar
system. Voyager's cameras revealed
several clearly defined Neptunian
storm systems, including one dubbed
the Great Dark Spot. Triton, the
largest of Neptune's eight moons,
nearly upstaged its planet during the
encounter when scientists detected
nitrogen volcanoes erupting on its
surface.

Uranus

Voyager 2 found Uranus to be cloaked
by a largely featureless atmosphere,
but the probe did manage to discover
10 satellites, boosting the planet's
count to 15. The biggest surprise was
that the axis of Uranus' magnetic field
is not aligned with the axis of rotation.
More visually arresting was the moon
Miranda, a strangely chaotic world
that appears to have once shattered
and reformed.

- United States
- USSR
- ESA
- Japan
- Germany
- International

Design and Production:
Phil Jordan and Julie Schieber
Photo credits: NASA, JPL.
Halley's Comet: Geoff Chester.
Halley's close-up: Max Planck
Institut für Astronomy

ioneer 10

r system, Jupiter is
and helium that
nt storm systems.
bes, although buf-
radiation, greatly
he planet and its
eer 11 hinted that
confirmed it.











INTREPID



T



THE NEW DODGE

A DIVISION OF THE CHRYSLER CORPORATION

Mrs. Blume's Science Class Is A Blast.



Thanks to Denise Blume's interest in flight, her students are reaching new heights in their science studies.

Denise, a third-grade teacher at Bayou Woods Elementary School in Slidell, Louisiana, is the creator of an inventive learning program entitled "Wings."

"What I do with 'Wings,'" explains Denise, "is channel their excitement about flight into an excitement about science."

Denise accomplishes this with a variety of dynamic projects that emphasizes hands-on experience. For example, after studying the design and purpose of rockets, the students construct and launch their own model rockets. They also learn the fundamentals of aerodynamics by designing and flying their own paper airplanes.

Yet, the highlight of the program is a class trip to the Stennis Space Center in Mississippi.

"The tour," says Denise, "is a miniature history lesson. It helps them understand the profound influence aviation and aerospace have had on their lives."

State Farm is delighted to present Denise with our Good Neighbor Award, along with a contribution of \$5,000 to Bayou Woods Elementary School in her name.

Denise Blume. Thanks to her imaginative ways, her students are receiving a top-flight education.



STATE FARM INSURANCE COMPANIES
Home Offices: Bloomington, Illinois

Good Neighbor Award

The Good Neighbor Award was developed in cooperation with the National Science Teachers Association (NSTA).